

J. K. TURNER

SERVICE AND PARTS CATALOG

PARTS AVAILABILITY
NO LONGER GUARANTEED

**SERIES
CW**

ELECTRIC GENERATING PLANTS

ONAN

GENERATOR DIVISION
Studebaker
CORPORATION

2515 UNIVERSITY AVE. S.E. MINNEAPOLIS, MINN. 55405
IN CANADA: ONAN GENERATORS CANADA LTD., P.O. BOX 652, GUELPH, ONT. N1H 6Y6

920-400

9AL88 Pth

Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC-rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work-harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.

- **Warning:** Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [-] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (-) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not service control panel or engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocution can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [-] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [-] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training are required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Induced voltage remains even after equipment is disconnected from the power source. Plan maintenance with authorized personnel so equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

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ONAN ELECTRIC GENERATING PLANTS CW SERIES

920-400

9AL66

THIS MANUAL SUPERSEDES MANUALS 920-14, 920-100, 920-500 AND 920-1010 WHICH ARE NOW OBSOLETE AND NO LONGER STOCKED BY ONAN.

INTRODUCTION

When instructions in this manual refer to a specific model of generating plant, the model in question can be identified by referring to the MODEL AND SPEC (specification) NO. as shown on the plant nameplate. A typical example is given, with explanatory notes. Electrical characteristics of the plant are shown on the nameplate lower portion.

TYPICAL MODEL AND SPEC NO.

705CW - 3R		131E	
↓	↓	↓	↓
1	2	3	4

See Note

NOTE

EXPLANATION

- 1 - Factory code for general identification purposes.
- 2 - Specific *TYPE*, as follows:
 - M* - *MANUAL* type. Hand crank starting. Suitable for permanent or portable installations.
 - R* - *REMOTE* type. Electric starting. Suitable for permanent or mobile installations. Optional accessory equipment can be connected for remote or automatic control of starting and stopping.
 - E* - *ELECTRIC* start type. Electric starting at the plant only.
- 3 - Factory code for specific optional equipment supplied.
- 4 - Specification (Spec Letter), advances with factory production modifications.

Some details of these instructions may not apply to special models having modifications specified by the purchaser. Due to the wide variety of uses for which these plants are suitable, these instructions must be of a general nature. However, by using the instructions and recommendations given in this manual as a general guide, it is possible to properly maintain the plant.

Instructions for 60-Cycle, 1800 rpm plants apply also for 50-Cycle, 1500 rpm plants except for current frequency and operating speed. Be sure appliances are adaptable to the current frequency of the plant.

The engine end is designated as the *front end* of the plant. *Left side* and *Right side* of the plant are determined by viewing from the front end. Cylinder number one (nearest the timing gears) is on the *Left Side* of the plant.

ENGINE DETAILS

Type: Horizontal opposed 2-cylinder, 4-stroke cycle, L-head
Bore: 4-inch (cylinders removable)
Stroke: 3-1/2-inch
Displacement: 88-cubic inches
Compression Ratio: 5.8 to 1
Horsepower: 5CW - at 1800 rpm 17.0 - 705CW and 10CW - at 1800 rpm 20.0
Piston: Aluminum alloy - 3-ring
Connecting Rods: Forged steel
Connecting Rod Bearings: Replaceable precision type - 2-3/8" diameter
Main Bearings: Replaceable precision sleeve type - 2-3/4" diameter
Crankshaft: Forged steel, counter-weighted and balanced
Camshaft Bearings: Sleeve type, babbitt faced, steel backed
Lubrication: Pressure, gear driven, gear type oil pump - oil filter
Oil Capacity: 6 U.S. quarts
Valves: Stellite faced exhaust valves and seats
Tappets: Adjustable
Governor: Internal centrifugal flyball type, external adjustments - Vacuum operated speed booster on some models
Ignition: Impulse coupling magneto, alternate firing
Cooling: Air, single vent

GENERATOR DETAILS

The output generator is a revolving armature type. The AC models are self excited, inherently regulated. The inherent design of the saturated, 4-pole, shunt wound field generator assures close voltage regulation between no load and full load conditions. A special series winding in the field of the AC remote starting models permits the generator to be used as a starting motor (DC magnet service models use a separate automotive type starter). The armature is directly connected to the engine and is supported at the outer end by a large ball bearing. Approximate operating speed is 50-cycle at 1500 rpm, 60-cycle at 1800 rpm, and DC magnet service models at 1960 rpm.

MEMORANDUM

OPERATION

CRANKCASE OIL

Use a good quality detergent oil classified for service "DG" or "MS/DG". Fill the plant to the full (F) mark on the indicator. Do not over fill.

Above 90°F	SAE 50
30°F to 90°F	SAE 30
0°F to 30°F	SAE 10W
Below 0°F	SAE 5W (5W-20 if 5W is not available)

NOTE: Always tighten the oil fill cap securely to maintain vacuum in the crankcase. A loose oil fill cap or damaged gasket will destroy the vacuum. Loss of vacuum may result in excessive oil consumption or in an oil leak past the crankshaft oil seals.

GASOLINE FUEL

Use fresh regular grade automotive gasoline. DO NOT use highly leaded premium. Never fill the tank when the engine is running. Leave some space for fuel expansion as the plant warms up.

GAS FUEL

Be sure that all connections are leakproof. See that the regulator is properly adjusted, refer to instructions supplied with regulator.

PRELIMINARY

Starting batteries **MUST BE CONNECTED** to plants designed for electric starting unless special precautions are taken as explained under **OPERATING WITH BATTERIES DISCONNECTED**.

Caution: ALWAYS BE SURE THAT ALL AIR HOUSING PARTS (cylinder air covers, blower housing) ARE PROPERLY INSTALLED BEFORE STARTING THE PLANT. The air housings direct the air flow to properly cool the engine and generator. UNLESS EACH AIR HOUSING PART IS CORRECTLY FASTENED IN PLACE, SERIOUS DAMAGE FROM OVER HEATING WILL RESULT.

STARTING (electrically cranked models).

(1) See that the small toggle switch on the control box is at the **ELECT START** position. (2) Push the **START-STOP** switch to the **START** position. THE PLANT MAY HESITATE FOR SEVERAL SECONDS BEFORE CRANKING PAST COMPRESSION ON THE FIRST REVOLUTION.

HOLD THE START SWITCH CLOSED FOR THIS HESITATION PERIOD. THE ENGINE WILL CRANK OVER COMPRESSION AND THEN GAIN NORMAL CRANKING SPEED.

A sharp, distinct clicking sound will be heard as the engine is cranking, indicating that the magneto impulse coupling is operating. The sound will disappear as soon as the engine starts and picks up running speed.

Warning: When battery is nearly discharged or has less than 100-ampere hour capacity, prolonged cranking attempts will damage the generator commutator. The engine cranks too slowly and cranking limiter gets insufficient current to stop cranking attempt.

If the plant starting batteries do not have sufficient cranking power, or if the plant cannot be cranked electrically for other reasons, the plant can be started manually. Disregard manual choking instructions when hand cranking a plant designed for electric starting. However, do not disconnect the starting batteries unless a wire in the control box is first disconnected, as explained under **Operating with Batteries Disconnected**.

OPERATING WITH BATTERIES DISCONNECTED

If operation with batteries disconnected becomes necessary on a plant designed for electric starting, the generator dc output must be disconnected from the charging circuit. Beginning with Spec H models, disconnect the center wire (connected to fixed terminal) from the charge resistor, figure 1A. On Spec A through G models, disconnect the single wire at the end of the 3 charge resistors, figure 1B. Beginning with Spec F models, the Sisson manufactured choke is used and the carburetor must be manually choke while hand cranking.

Tape up the ends of the disconnected wires, to prevent a short circuit. After the dc output wire is disconnected, the plant can be started and safely operated without batteries.

Be sure to reconnect the wires when batteries are again connected to the plant. Throw the small toggle switch to the **HAND CRANK** position, to permit starting and running.

Caution: Turned out relays in the battery charging circuit will result if the plant is run without batteries unless this wire is disconnected.

STARTING THE PLANT MANUALLY

On plants with manual choke control adjust to choke the carburetor according to temperature conditions.

Manual starting models (and some electric starting models) are equipped with a primer on the fuel pump. On the initial run, or if the plant has run out of fuel, operate the fuel pump primer 10 to 20 strokes to properly fill the carburetor.

If the plant is the electric starting type, throw the small toggle switch on the control box to the **HAND CRANK** position. Return the switch to the **ELECT. START** position as soon as the plant starts, unless *operating with batteries disconnected*.

When the plant is equipped with an optional low oil pressure cutoff switch a momentary contact switch is mounted on oil filter bracket and must be held open to remove the ignition ground during hand cranking.

Engage the starting crank. Crank the engine with a quick upward pull on the crank handle. A sharp clicking sound will be heard, indicating that the magneto impulse coupling is functioning. This sound disappears as soon as the engine starts. Do not spin the engine nor push downward on the crank. Repeat the cranking as necessary, using only upward pulls on the crank handle. Remove the crank as soon as the plant starts.

WARM UP PERIOD

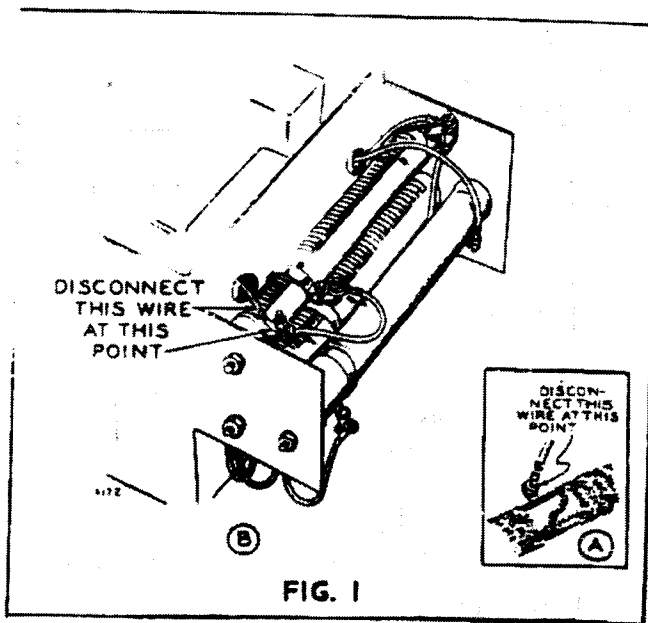
On plants with manual choke adjust the manual choke control to the point of smoothest operation. As the plant warms up, gradually push the choke control inward. Be sure the choke is all the way in when the plant is fully warmed up. If operating an electric starting model without batteries, it will be necessary to loosen the electric choke at the carburetor and rotate the choke housing manually.

Check the oil pressure as indicated on the oil pressure gauge. The oil pressure should be between 20 and 30 pounds, but may be somewhat higher until normal running temperature is reached.

If conditions permit, allow the plant to warm up before connecting the electrical load. If the plant tends to alternately speed up and slow down, it is usually an indication that more warm up time is needed before connecting a heavy electrical load.

STOPPING THE PLANT

If conditions permit, disconnect the electrical load before stopping the plant. To stop the plant, press the **START-STOP** switch to the **STOP** position, holding contact until the engine comes to a complete stop. If the **STOP** switch is released too soon, the engine may pick up speed again



and continue to run. The **STOP** switch on manual starting models is a small button on the rear of the magneto.

If an electric starting model is being operated with the starting batteries disconnected, throw the small toggle switch to the **ELEC. START** position, to stop the plant. The **STOP** switch (and all other control box equipment) is by-passed when the toggle switch is at the **HAND CRANK** position.

DURING OPERATION

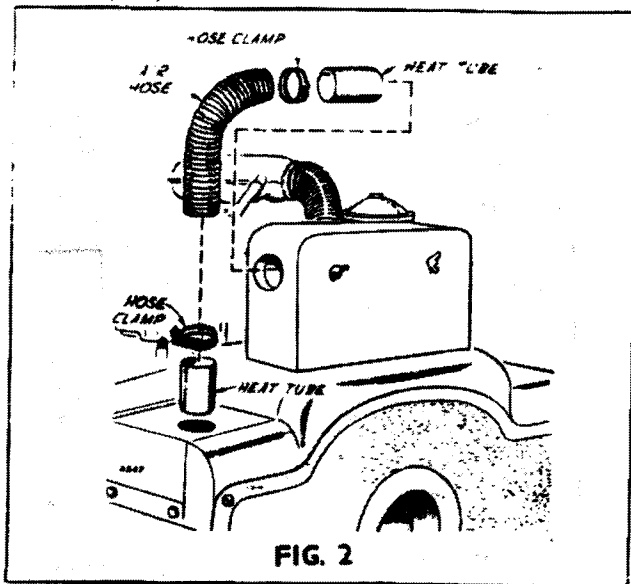
The generator is designed so that a temporary heavy over load, such as exists while starting an electric motor, will not injure the generator. However, continuous heavy over loading of the generator will cause the generator temperature to rise to a dangerous point, and may lead to failure of the windings. The generator is designed to produce its rated capacity continuously, or a 25% over load for a period of less than 2 hours, under normal temperature conditions.

On single phase plants, if two 120-volt circuits are used, not more than 1/2 the rated capacity of the plant should be connected to either **ONE** circuit. On three phase plants, if part of the load is single phase, the total load on any one circuit should not exceed 1/3 the rated capacity of the plant.

OPERATION BELOW 50°F (10°C).

Under conditions where the air temperature is 50°F or lower, and the humidity is quite high, ice formation inside the carburetor may occur. Under such conditions, connect the air preheater hose to direct hot air to the air cleaner.

NOTE: For best operation, disconnect the air heater hose when the surrounding air temperature is 60°F. or higher. No harm will result from leaving the hose connected at higher temperatures, but a slight drop in power and lowered efficiency may occur.



GAS FUEL OPERATION

A special carburetor is used on plants equipped for gas fuel operation. If an emergency source of gasoline fuel is also connected, see that the gasoline shut off valve is closed. See that the choke is properly locked in its wide open position. (On early models with float lock screw, turn screw in tightly to support float - float locking screw is not used on later models.)

Plants equipped with an Ensign regulator have a special choke adapter attached to the carburetor and may require priming when starting. Plants equipped with a Garretson regulator require no choking or priming when starting.

If gasoline fuel is going to be used to operate a plant equipped for gas fuel, a few preliminary change-over steps are necessary.

1. Be sure the gas fuel supply is turned off. If the gas supply line is disconnected, install a plug in the regulator inlet. If the gas connection hose is disconnected, close the carburetor gas adjusting screws to prevent any entry of air through the gas inlet opening.
2. Release the automatic choke lock to permit normal choke operation. Check to be sure the choke operates properly.
3. Open the gasoline shut off valve. (On early models with float lock screw, turn screw fully out.)

LPG (LIQUID PETROLEUM GAS) OPERATION (Zenith Pressure-Carburetor)

No choking is required for starting. The fuel supply valve is a part of the carburetor and opens only when a pressure drop, as created by cranking the engine, causes the regulating diaphragm to move. However, the carburetor has a pop-valve type choke plate which is held open by a spring but can be used if the need arises.

ABNORMAL OPERATING CONDITIONS

HIGH TEMPERATURES

1. See that nothing obstructs the air flow to and from the plant.
2. Keep the cooling fins clean. See that the air housings are properly installed and undamaged.
3. Keep the ignition timing properly adjusted.
4. If the plant is to be operated consistently in temperature conditions above 90°F (32.2°C), battery life can be maintained by reducing a fully charged battery's specific gravity to a 1.225 reading. Onan instruction sheet A45 gives the procedure.
5. Check battery electrolyte level frequently. Add approved water as often as necessary.

LOW TEMPERATURES

1. Use the proper SAE No. oil for the temperature conditions. Change oil only when warm from running. If an unexpected temperature drop causes an emergency, move the plant to a warm location or apply heat gradually directly to the oil base until oil will flow freely. Thoroughly warm up plant and change oil to the proper SAE number for temperature conditions as recommended under OPERATION.
2. Use fresh, winter grade (not premium) gasoline. Protect against moisture condensation. Leave room in tank to allow for expansion.
3. Plants with oil bath type air cleaner, use same SAE No. oil as in the crankcase.
4. Keep the ignition system clean and properly adjusted. Keep batteries in a well charged condition.
5. Use a hot range spark plug, Champion K-15J or equivalent. A colder type spark plug will soon become fouled. Earlier used 8 COM plug cannot be used because of a manufacture's change to a smaller hex size shell.
6. Certain types of LPG (gas fuel) do not vaporize readily at low temperatures. Consult the fuel supplier if lowered performance is noted.
7. When plant is operated in temperatures of 32°F (0°C) or lower, over cooling will result unless the hot air discharge is partially restricted.

DUST AND DIRT

1. Keep the plant clean. Do not allow cooling fins to become coated or obstructed with debris.
2. Service the air cleaner as frequently as necessary.

3. Change crankcase oil every 50 operating hours.
4. Keep oil and gasoline supplies in dust-tight containers.
5. Keep the governor linkage connections clean.
6. Keep the generator brushes, slip rings, and commutator (when used) clean.

HIGH ALTITUDE

For operation at altitudes of 2500-feet or more, close the carburetor main jet adjustment slightly, to maintain proper air-to-fuel ratio. Refer to the ADJUSTMENTS section. Maximum power will be reduced approximately 4-percent for each 1000-feet above sea level.

PREPARING UNITS FOR STORAGE OR EXTENDED OUT-OF-SERVICE PERIODS.

Engines taken out of service for extended periods of time, in many cases are left to stand idle without being protected against possible damage from rust and corrosion or the elements. The factory recommends that any unit to be removed from service for 30 days or more be protected as follows:

1. Shut off the fuel supply at the tank and allow the unit to run until it stops from lack of fuel. The fuel system will then be free of gasoline except for the tank.

If the fuel tank will be subjected to temperature changes, fill the tank nearly full to lessen chances of condensation forming within the fuel tank.

2. Drain the oil from the oil base while the engine is warm. Replace the drain plug. See that the oil fill cap or plug is in place.
3. Remove each spark plug and pour two tablespoonfuls of rust inhibitor oil (Use SAE-50 motor oil as a substitute) into each cylinder. Crank the engine over slowly by hand to lubricate the cylinders. Stop the engine with the TC (top center) mark on the flywheel indicating at least one piston is at top center position. Replace the spark plugs.
4. Remove, clean and replace the air cleaner per instructions under Periodic Service.
5. Wipe all exposed parts clean and coat with a film of grease all such parts liable to rust.
6. Oil the governor to carburetor linkage with SAE 50 oil.
7. Plug the exhaust outlet with a wood plug to prevent entrance of moisture or foreign matter.

8. Clean the generator brushes, brush holders, commutator and collector rings by wiping with a clean cloth. Do not coat with lubricant or other preservatives.
9. Where batteries are likely to be exposed to freezing temperatures, they must be removed and stored where there is no danger of freezing. A fully charged battery can withstand very low temperatures but an idle battery gradually loses its charge and may become discharged to the point where it will freeze. An idle battery should be given a freshening charge about every 40 days.

If battery is not to be removed, disconnect the cables from the unit. Arrange the cables so that the lugs cannot come in contact with each other or with metal parts.

10. Provide a suitable cover for the entire unit, particularly if it will be exposed to the elements.

RETURNING THE UNIT TO SERVICE

1. Remove all protective coatings of grease from external parts. Wipe the entire unit clean of accumulated dust or other foreign matter.

2. Inspect the unit carefully for damage and for other conditions requiring attention. Service as needed.
3. Remove the plug from the exhaust outlet.
4. Remove, clean and adjust spark plugs. While the plugs are out, crank the engine over several times by hand to distribute oil over the cylinder walls. If the cylinders are dry, put a tablespoonful of oil into each cylinder and crank the engine several turns by hand to distribute the oil. Replace the spark plugs and gaskets.
5. Examine all fuel and oil connections. Service as needed.
6. Refill the crankcase with the correct amount and grade of oil.
7. Lubricate governor linkage ball joint with powdered graphite.
8. Check carefully for leaks of fuel or oil after servicing the unit. Correct any leaks before starting the unit.
9. Connect the battery cables to unit. Carefully recheck to make sure the unit is ready for operation. Then start the unit in the regular manner as described under OPERATION.

THE FOLLOWING MAINTENANCE IS RECOMMENDED TO KEEP THE PLANT IN GOOD OPERATING CONDITION. NEGLECT OF ROUTINE SERVICING MAY RESULT IN FAILURE OF THE PLANT AT A TIME WHEN IT IS URGENTLY NEEDED. THE CHART IS BASED ON UNITS OPERATING UNDER FAVORABLE CONDITIONS SUCH AS: PROPER INSTALLATION, RECOMMENDED FUEL AND OIL, NORMAL LOAD, ETC.

PERIODIC SERVICE CHART

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS							REFER TO SERVICE NOTES
	8	50	100	200	500	1000	5000	
General Inspection	x							A
Check Fuel Supply	x							B
Check Oil Level	x							C
Service Air Cleaner:								
Oil bath type	x							D
Dry element type	x							D
Dry cartridge Type (folded paper)		x*						D
Governor Linkage		x*						E
Battery		x						F
Spark Plugs			x					G
Change Crankcase Oil		**	x*					H
Crankcase Breather			x					I
Fuel System				x				K
Check Ignition Points				x				L
Replace Oil Filter Element				x				M
Generator Brushes, Commutator and Collector Rings				x*				N
Clean Carbon and Lead					x			O
Check Tappet Clearance					x			
Clean Carburetor						x		
Grind Valves						x		
Clean Generator						x		
Lubricate Generator Bearings†						x		
Complete Reconditioning							x	

* - Service more often under extreme dust conditions.

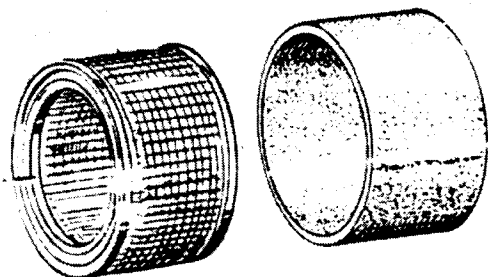
** - See service note H.

† - Does not apply to shielded type bearings used on all later models.

SERVICE NOTES

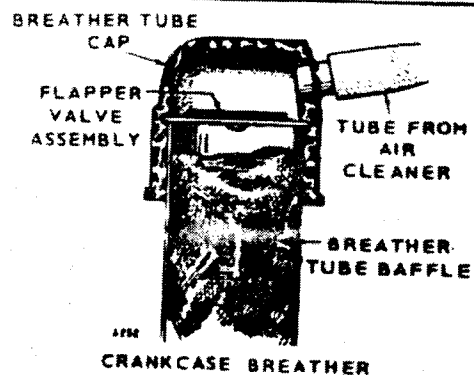
- A. - Inspect for leaks, loose connections, etc. **KEEP PLANT CLEAN!**
- B. - **FUEL SUPPLY.** Avoid running out of fuel. Never fill tank while plant is running. Use clean, fresh "regular" grade gasoline. Never fill completely, leave some for expansion. All manual start models (and some remote control models) have a manual priming lever on the fuel pump. When priming lever is used to fill the carburetor, be sure to leave the lever in down position when through priming.
- C. - **OIL LEVEL.** Keep level at the full mark. When adding use the same brand as in crankcase. Tighten oil fill cap securely.
- D. - **AIR CLEANER.** Service the air cleaner as often as required by the operating conditions. Under extremely dusty conditions it may be necessary to service the air cleaner several times a day.
1. "Oil bath" type air cleaner (Spec A Models) - Clean and refill cup with fresh oil to level indicated. Use oil of the same SAE No. as in the crankcase. Clean the filter element in solvent, dry and re-assemble air cleaner.
 2. "Mesh element" type air cleaner (Spec B through F Models) - Remove pack element, wash in solvent and dry. Re-oil with the same SAE No. oil as is in the crankcase. Drain excess oil and re-install.
 3. "Dry cartridge" type air cleaner (Begin Spec G Models) - **NEVER WASH FOLDED PAPER CARTRIDGE.** Each 50 hours or oftener, remove cartridge and shake out accumulated dirt. Replace cartridge each 500 hours or oftener. When cartridge has a foam wrapper, carefully remove and wash wrapper clean fuel, then dry and re-install.
- E. - **GOVERNOR LINKAGE.** Use lubricating graphite on the ball joint and point where link engages the carburetor throttle arm. If graphite is not available, use a non-gumming sewing machine oil.
- F. - **BATTERY.** Check charge condition. Check electrolyte level. Add approved water to keep the electrolyte to its proper level. In freezing weather, add water only before running the plant. Keep battery connections tight and clean.
- G. - **SPARK PLUGS.** Remove plugs. Clean and adjust gap, refer to Table of Clearances. If plug fails to pass a standard compression firing test, replace.
- H. - **CRANKCASE OIL.** - Change oil only when warm after operating. If oil is too cold to flow, refer to Abnormal Operating Conditions, Low Temperatures.
- I. - If engine is operating in extremely low temperatures or for short operating periods: with highly leaded gasoline; or in extremes of dust and dirt, then change oil every 50 hours instead of 100 hours.
- J. - **CRANKCASE BREATHER.** Remove the breather hose and cap, carefully remove the fabric type check valve. Wash in fuel, dry and re-install positioning perforated disc toward engine.
- Valve must maintain a partial vacuum in crankcase to help control oil. If faulty install a new valve. If baffle (mesh) in breather tube is clogged, lift out and wash it.
- K. - **FUEL SYSTEM.** Empty carburetor and fuel filter bowls of any accumulated sediment. Clean filter screen thoroughly. Re-assemble and check for leaks.
- L. - **IGNITION.** Remove magneto end cap and inspect breaker points. Replace burned or faulty points, this usually is an indication of a defective magneto condenser which also should be replaced. If only slightly burned, remove and dress smooth with a fine stone. Adjust gap with the tubing arm on the high side of its cam, refer to Table of Clearances. If cam oil wick is dry and hard install a new factory impregnated wick. Magneto bearings do not require lubrication until magneto is disassembled for overhaul.
- M. - **OIL FILTER.** The time intervals for filter cartridge replacement may vary depending on operating conditions. Remove cartridge, if it appears to be filling with sludge, install a new one. Always clean out oil filter body before installing the cartridge. A new filter will absorb a pint or more of oil when engine is started. After running a few minutes, stop the plant and add oil to bring the level up to the "F" mark on indicator.
- N. - **GENERATOR.** Clean commutator and slip rings with a dry cloth. If heavily coated or rough, sand smooth with #00 (fine) sandpaper - never use emery (or other conductive) abrasives. Replace brushes when worn to 1/2-inch in length. Do not disturb the brush rig to install brushes. Use only brushes specified (never substitute) in the parts list. If sparking occurs, run plant at a light load until brushes wear to a good seat.
- O. - **MAJOR ENGINE SERVICE.** Remove carbon and lead deposits from combustion chamber, valves etc. as often as experience dictates, depending on operating conditions. Adjust tappets (cold setting). Clean entire generating plant to insure efficient cooling and operation. Perform other services as inspection or operation shows necessary.

**DO NOT WASH
CARTRIDGE!**



**NOTE: EARLIER MODELS USED OIL
BATH TYPE OR MESH ELEMENT
TYPE AIR CLEANER.**

FIG. 3



Remove breather cap. Remove valve from cap. Wash valve in fuel. Dry and install with perforated disc toward engine. If faulty, install new valve.

FIG. 4

ADJUSTMENTS

CARBURETOR

Carburetors used, differ according to the fuel to be used. However, the adjustment is basically the same. The location of the adjustments differ.

The carburetor has a fuel main adjustment and fuel idle adjustment. The main adjustment affects the operation at the heavier load conditions. The idle adjustment affects the operation at light or no load conditions. If the adjustments have been disturbed, open them off their seats, 1 to 1-1/2 turns to permit starting, then, adjust them for smoothest operation.

Before final adjustment allow the engine to thoroughly warm up. Adjust the idle adjustment with no load connected to the generator. If available, connect a voltmeter of the proper range to the generator output. Slowly turn the idle adjustment out until the engine speed (or generator voltage) drops

slightly below normal. Then turn the needle in until the speed (or voltage) returns to normal.

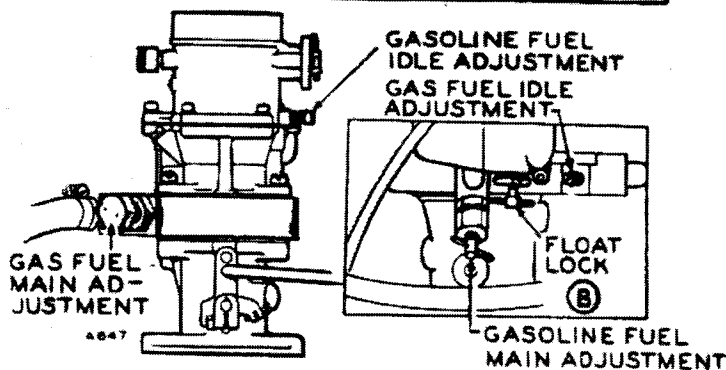
To adjust the fuel main adjustment, apply a full electrical load to the generator output. Turn the main adjustment in until the engine speed (or generator voltage) drops slightly below normal. Then turn the needle out until the speed (or voltage) returns to normal. Proper carburetor adjustment cannot be assured unless the governor is properly adjusted.

The gasoline carburetor float setting, from the bottom of the float to the air intake body, is 1-1/4" (plus 1/8", minus zero).

With electric load removed, adjust the throttle lever stop screw to prevent a voltage output drop below 75-percent of rated voltage (or so that there is 1/32-inch clearance at the end of the stop screw while running at rated speed under no load).

DOWNDRAFT TYPE CARBURETOR

GAS-GASOLINE CARBURETOR SHOWN. GASOLINE (ONLY) CARBURETOR DOES NOT HAVE GAS ADJUSTING VALVES.



LPG PRESSURE CARBURETOR

GAS FUEL MAIN ADJUSTMENT

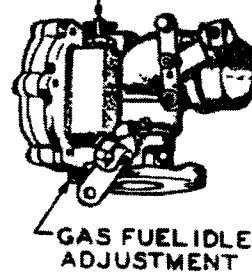


FIG. 5

AUTOMATIC CHOKE

Various types of automatic chokes have been used. Select the illustration according to type and plant specification. figure 6. Extremes in temperature may require re-adjustment of the choke. If the choke does not open as the plant warms up, check the electric heating element to be sure it is operating.

On gas-gasoline carburetor, be sure the choke lock wire is inserted when operating on gas fuel.

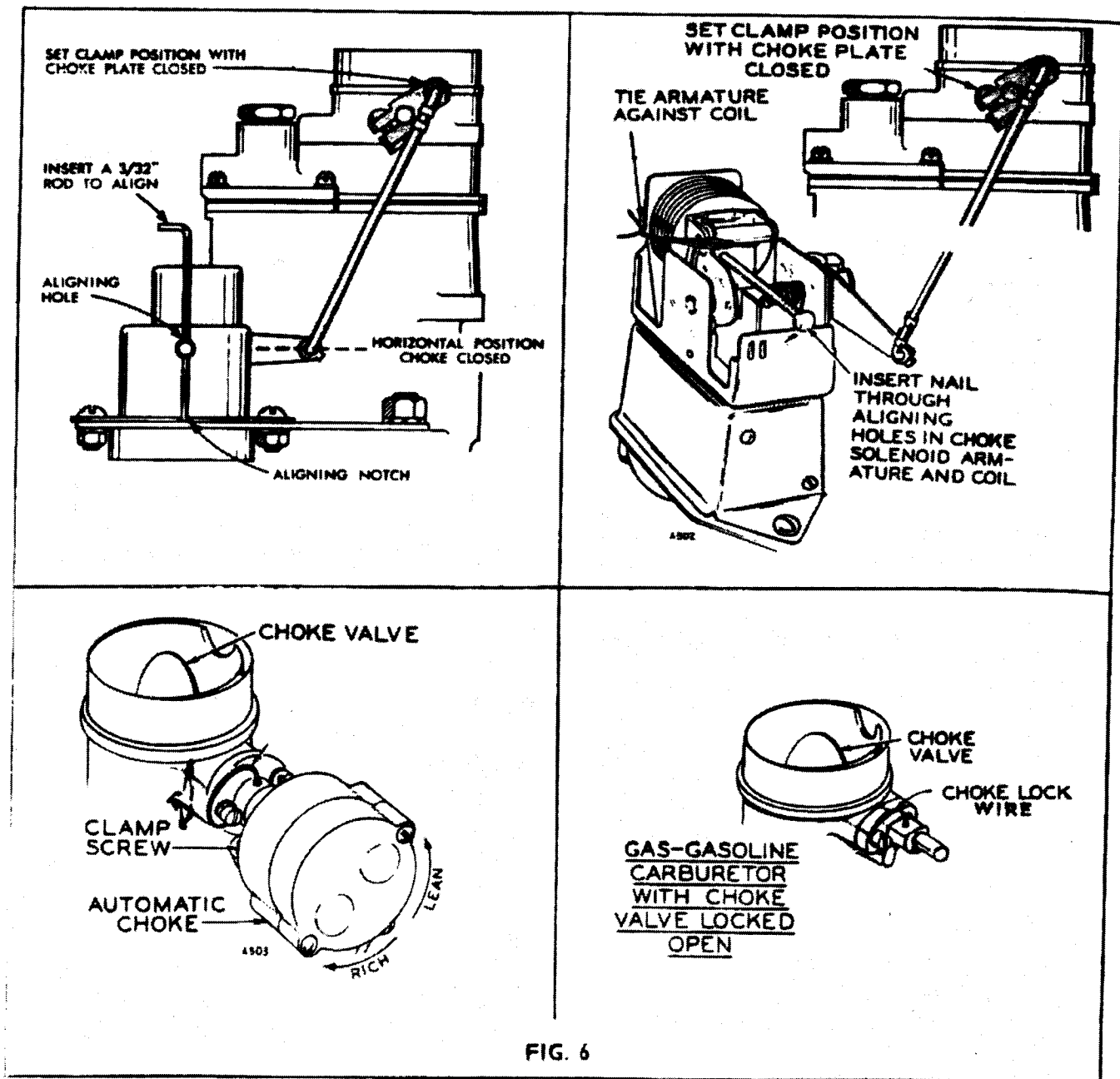


FIG. 6

GOVERNOR

The governor controls the engine speed, and therefore the voltage and frequency of the generator output. The 60-cycle plants are adjusted at the factory to a maximum no load speed of 1890 rpm, 50-cycle plants are similarly adjusted to 1590 rpm maximum. These are maximum figures, and may sometimes be as low as 1800 rpm for 60-cycle or 1500 for 50-cycle plants. A voltmeter or frequency meter (preferably both) should be connected to the generator output in order to correctly adjust the governor.

PRELIMINARY STEPS

1. With the plant stopped, the clearance between the carburetor stop lever should be approximately $1/32''$, Fig. 7. This clearance can be adjusted by turning the ball joint on the link.

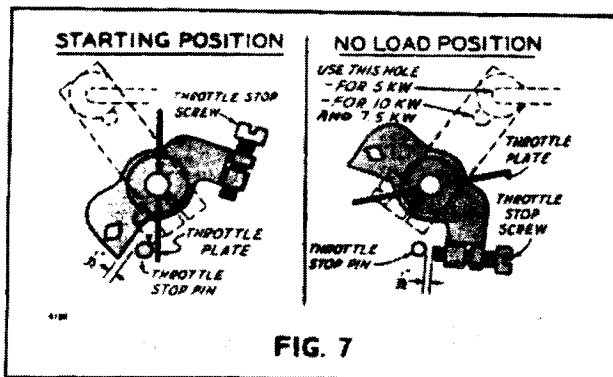


FIG. 7

Pull the governor arm gently toward the front of the engine several times. Any binding, sticking or excessive looseness in the travel will cause erratic governor action. The action must be smooth subject to the tension of the governor spring.

2. Start the plant and run at a light electrical load long enough to thoroughly warm up. If the governor is completely out of adjustment, make a preliminary adjustment at no load to first attain a safe voltage operating range. The plant must be thoroughly warmed up before a satisfactory final governor adjustment can be made.

SPEED-BOOSTER

Many models of the CW series are equipped with an auxiliary speed booster device, operating by intake manifold vacuum. After satisfactory performance under various loads has been attained by governor adjustments without the booster, the booster can be connected. Connect the booster external spring to the bracket on the governor link (rod). With the plant operating at no load, slide the bracket on the governor link just to the position where there is no tension on the external spring.

Apply a full rated electrical load to the generator. The output voltage should stabilize at nearly the same reading for full load as for no load operation. The speed may remain about the same or increase when the load is applied, resulting in a frequency 1 or 2-cycles *higher than* the no load frequency. (1-cycle is equal to 60-rpm for a 2-pole generator). If the rise in frequency is more than 2-cycles, lessen the internal spring tension. If there is a drop in the frequency, increase the booster internal spring tension. To increase the tension, pull out on the spring bracket, and move the pin to a different hole.

With the booster disconnected, a maximum drop of 3-cycles from no load to full load is normal. With the booster in operation, a maximum *increase* of 2-cycles from no load to full load is normal. A drop of 1-cycle at $1/4$ load is permissible, giving an overall spread of 3-cycles, maximum.

The effect of the booster is limited by the general condition of the engine. The booster cannot compensate for a loss in engine vacuum caused by leaky valves, worn piston rings, etc.

The booster requires little maintenance other than using a fine wire to clean the small hole in the short vacuum tube which fits into the hole in the top of the engine intake manifold. Do not enlarge this hole. If there is tension on the external spring, when the plant is operating at no load or light load, it may be due to improper adjustment, restricted hole in the small vacuum tube, or a leak in the booster diaphragm or gasket.

TABLE OF GOVERNOR ADJUSTING LIMITS

PLANT RATED NO LOAD VOLTS VOLTAGE	MINIMUM FULL LOAD VOLTS (MAXIMUM)	MAXIMUM NO LOAD TO FULL LOAD VOLT WITHOUT BOOSTER DROP WITH BOOSTER
120/240	124 OR 248	112 OR 224
240 3 PH 3 WIRE	248	224
480 3 PH 3 WIRE	496	448
120/208 3 PH 4 WIRE	224 (3 PHASE)	202 (3 PHASE)
230/380	408 3 PHASE	370 3 PHASE

* NOTE 3 PHASE FULL LOAD VOLTAGES SHOWN ARE WITH .8 POWER FACTOR LOAD

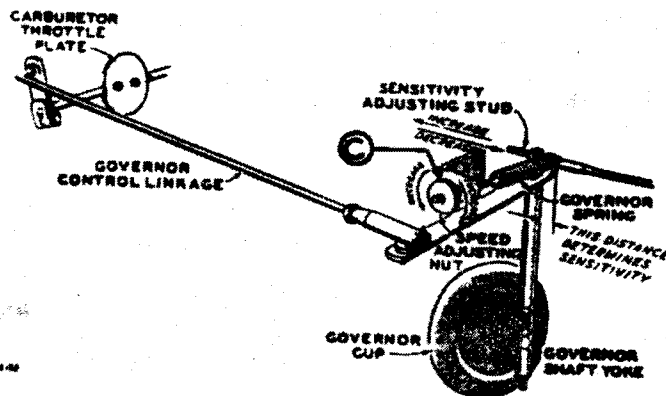


FIG. 8

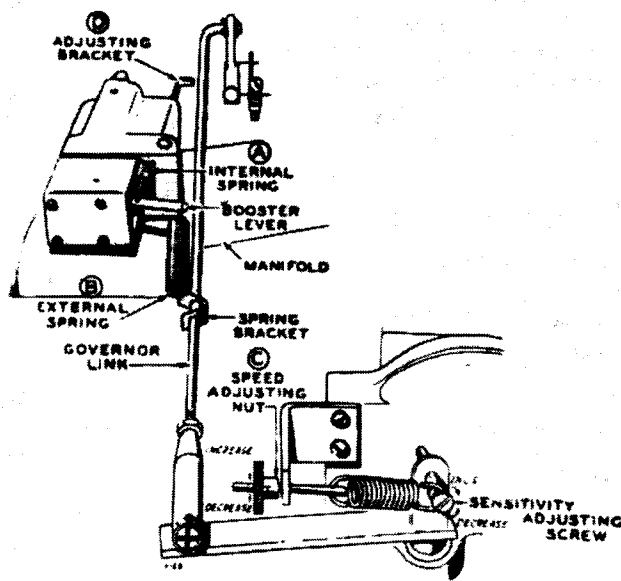


FIG. 9

MAINTENANCE AND REPAIR

GENERAL

Refer to the SERVICE DIAGNOSIS section for assistance in locating and correcting troubles which may occur. If a major repair or overhaul becomes necessary, the engine should be carefully checked and necessary repairs made by a competent mechanic. Major generator repairs should be made by a competent electrician. Maintain factory limits and clearances as given in the Table of Clearances, replacing worn parts when necessary. Avoid accidental shorts by disconnecting the battery when servicing control parts.

TABLE OF CLEARANCES

	Minimum	Maximum
Valve Tappets (cold)		.012"
Valve Stem in Guide - Intake	.0015"	
Valve Stem in Guide - Exhaust	.003"	.003"
Valve Seat Interference Width	3/64"	.0045"
Valve FACE Angle		5/64"
Valve SEAT Angle		44°
Valve Interference Angle		45°
		1°
Crankshaft Main Bearings - Aluminum	.0035"	.0045"
Crankshaft Main Bearings - "Bronze" Faced	.0019"	.0054"
Crankshaft End Play - Aluminum Bearings	.008"	.020"
Crankshaft End Play - "Bronze" Faced Bearings	.008"	.012"
Crankshaft Main Bearing Journal - Standard Size	2.7499"	2.7500"
Crankshaft Rod Bearing Journal - Standard Size	2.3745"	2.3750"
Connecting Rod Bearings	.001"	.003"
Connecting Rod End Play	.002"	.011"
Camshaft Bearings	.001"	.003"
Cylinder Bore - Standard Size	4.000"	4.001"
Piston to Cylinder (90° to pin)	.0045"	.0065"
Piston Pin in Piston (tap-in fit)	.0000"	.0003"
Piston Pin in Connecting Rod	.0002"	.0007"
Piston Ring Gap in Cylinder	.013"	.025"
Timing Gear Backlash	.001"	.006"
Oil Pump Gear Backlash	.003"	.005"
Magneto Breaker Points Gap		.015"
Spark Plug Gap - For Gasoline Fuel		.025"
Spark Plug Gap - For Gaseous Fuel	.015"	.018"

ASSEMBLY TORQUES

Assembly torques require the use of a torque wrench. These assembly torques will assure proper tightness without danger of stripping the threads. If a torque wrench is not available, estimate the degree of tightness. Be careful not to strip the threads. Check all studs, nuts and screws often. Tighten as needed to prevent them from working loose.

TORQUE SPECIFICATIONS

Rear Bearing Plate -	
Place Bolts (No Locks)	45-50
Nuts (Earlier Models)	18-20
Connecting Rod -	
Place Bolts (No Locks)	40-45
Screws (With Locks)	27-30
Cylinder Head Screws	40-45
Crank Pilot Screw	43-48
Cylinder Base Nuts	58-62
Flywheel Mounting Screw	35-40

Intake Manifold Screws	25-30
Exhaust Manifold Screws	25-30
Generator Adapter Screws	25-30
Oil Base Screws	43-48
Fuel Pump Mounting Screws	15-20
Timing Gear Cover Screws	15-20
Armature Mounting Screws	10-12
Oil Pump Mounting Screws	7-9
Spark Plugs	25-30

ENGINE

GASKETS

Always use a new gasket when installing a part which requires a gasket. Be sure to thoroughly clean the surfaces that the gasket contacts before installation.

BLOWER HOUSING, REMOVAL

Remove the flat head screws mounting the front cover casting and pull the cover off straight forward. Remove the blower wheel from its hub. Remove the nuts and lock washers mounting the dual exhaust pipe to the cylinders, and 3 screws which mount the blower housing to the front of the engine. The blower housing, with the exhaust pipe loose inside it, can then be removed.

BLOWER HUB

Remove the screw and washer from the center of the blower wheel hub. Remove the crank pilot by pulling it straight forward. If the blower hub proves to be too tight for easy removal, tap lightly in a forward direction to loosen it.

VALVES

The exhaust valves and seats are of Stellite material, which is extremely hard and heat resistant. "Lap" grinding such valves is seldom successful. Dress the seats (both intake and exhaust) to an accurate 45-degree angle. Dress the valve faces to a 44-degree angle. This will provide a very narrow band of contact between valve face and seat, Fig 10. This results in better valve seating and lessens the chance of deposit build-up on valve seats and faces. Be sure to clean away all traces of abrasive, then oil the valves and guides lightly before assembling.

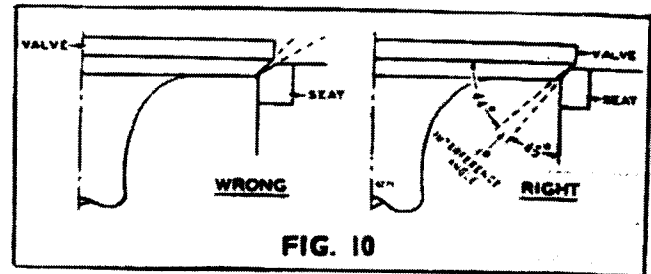


FIG. 10

VALVE TAPPETS

The valve tappets are adjustable, having self-locking adjusting screws. Set the tappets for clearance of .012" for intake and exhaust valves, at room temperature (cold setting). Tappets set too close may cause burned or warped valves or seats, scored tappets or camshaft lobes.

Be sure when checking the tappets, that the tappet being checked is riding on the low point of its cam lobe. Watch the valve to be checked as the engine is slowly hand cranked. As the valve closes, turn the crankshaft one complete turn beyond the valve closing point. This will assure that the tappet is then on the low point of its cam lobe.

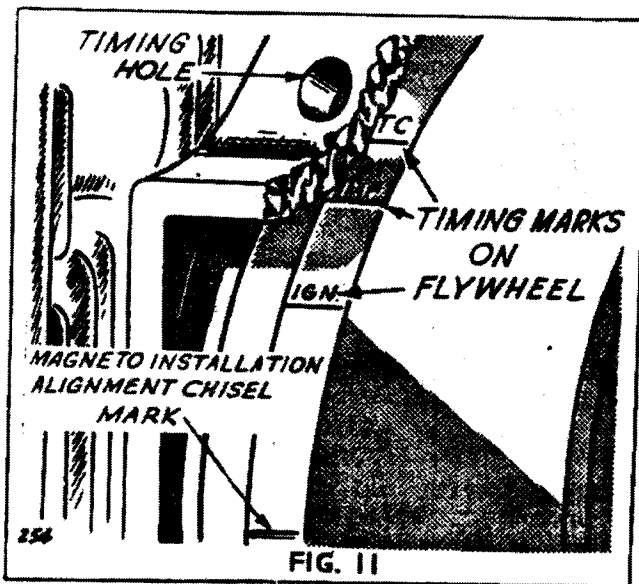
IGNITION TIMING

Correct ignition timing is important to good engine performance. The ignition timing should be checked after servicing or replacing the magnetic contact points. Refer to Fig. 11.

Remove the end cap from the magneto. Adjust the magneto breaker points to a gap of .015-inch at full separation. Remove the air cover from the engine right hand cylinder, to expose the timing hole in the flywheel housing.

With the hand crank, slowly turn the engine, until the IMP timing mark on the outside edge of the flywheel can be seen through the timing hole. As the timing mark centers in the

timing hole, a sharp click should be heard from the magneto. This click is caused by the magneto impulse as it trips, and is the instant the spark occurs. If this click occurs before the IMP mark is visible through the timing hole, the ignition timing will be "fast". If the click occurs after the IMP mark passes the center of the timing hole, the ignition timing will be "slow". Loosen the two magneto mounting screws a few turns each and turn the magneto slightly, to advance or retard the spark timing as necessary. Repeat the checking operation until proper timing is attained.



When the plant is running, the impulse coupling is no longer in operation and the spark is automatically advanced. If a neon timing light is used to check the timing, the spark should occur as the IGN. mark on the flywheel aligns in the timing hole.

MAGNETO GREASING

The magneto is lubricated at the factory. Renewing the grease in the field is inadvisable, unless the magneto is disassembled for another reason. If magneto overhaul becomes necessary, consult a Fairbanks Morse Authorized Magneto Service Station.

MAGNETO INSTALLATION

If the magneto has been removed from the engine, turn the flywheel to the point where the chisel mark, located 8-1/2 inches before TC mark, is visible through the timing hole. Holding the magneto in the hands, turn its drive gear in a clockwise direction until the gear locks (starts to wind impulse spring). Without changing this setting, carefully install the magneto to the engine, making sure the setting does not change as the gears mesh together. Check the timing as previously described.

GEAR COVER INSTALLATION

Before installing the gear cover, see that the metal-lined (smoothest) hole of the governor cup is properly aligned to engage the pin inside the gear cover. Install the gear cover,

leaving the mounting screws a turn or two loose. Carefully center the gear cover to avoid any off-center effect between the oil seal and the crankshaft. Hold in the centered position while tightening the mounting screws securely.

CYLINDERS

The cylinders are removable from the crankcase. If cylinders become worn more than 0.005" out of round or tapered, or are scored, they can be refinished to fit oversize pistons. If cooling fins are broken, or other damage occurs, replace the damaged cylinder with a new one. New engine cylinder bore is 4.000"-4.001", unless oversize cylinders and pistons are used, in which case the bore is 4.005 - 4.006".

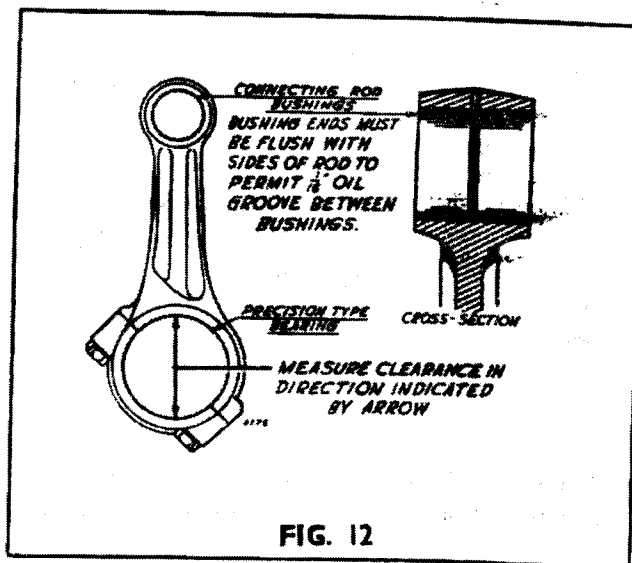
CYLINDER HEAD

Models using gaseous fuel have a high compression cylinder head. Beginning in 1959 this cylinder head has a 1/8" radius boss on the top edge to identify it from standard compression. This boss is externally visible through the spark plug hole in the cylinder air housing. Both heads must be of the same compression.

PISTONS AND RINGS

The pistons and connecting rods may be removed outward through the cylinders, or the cylinders can be removed over the pistons without loosening the connecting rods. Full floating type piston pins are used.

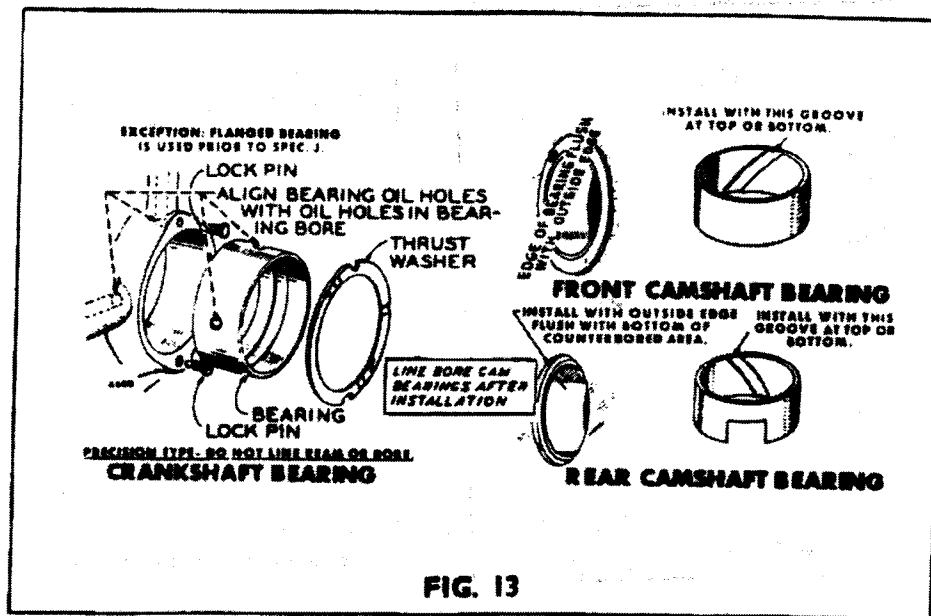
The compression rings have one edge beveled on the inside and this bevel must be installed toward the closed end of the piston. Proper ring gap, when fitting rings, is 0.013-inch to 0.025-inch. Space the ring gaps equally around the piston, with no gap directly in line with the piston pin. Use standard size rings if 0.005 oversize pistons are installed, and oversize rings for larger oversize pistons.



CONNECTING RODS

The forged steel connecting rods have precision type bearing inserts easily replaceable. Do not dress the rod cap to compensate for any bearing wear; replace with new bearings. Correct bearing clearance to the crankshaft journal is 0.001-inch to 0.003-inch, and should be measured at a point in line with the length of the rod. Fig. 12. If new piston pin

bushings are installed in the upper end of the rod, the bushings must be pressed in only flush with the sides of the rod, to permit a 1/16-inch oil groove at the center. Finish ream to 1.1879/1.8882-inch for a new piston pin, or to give a clearance of 0.0002" to 0.007" if a used pin is continued in service.



MAIN BEARINGS

The crankshaft main bearings are of the sleeve type. The "bronze" faced main bearing and separate thrust washer is original equipment, beginning on Spec J models. When used to replace the flanged aluminum bearing as used on models prior to Spec J, you must drill one additional hole and install a second lock pin to prevent each thrust washer from riding on the crankshaft.

Main bearings are available in standard, .002", .010", .030" undersize, and do not require finishing to size after installation. When driving or pressing the bearing in, align the oil passages in the bearing and bore. Oil the bearings. When installing the crankshaft, install a thrust washer at each end with grooved side against crankshaft and engaged with lock pins (coat with oil to hold while assembling). Measure the crankshaft endplay, see Table of Clearances.

CAMSHAFT BEARINGS

New camshaft bearings are precision type which DO NOT require line reaming or line boring after installation. Coat the bearing with lubricating oil to reduce friction. Place the bearing on the crankcase over the bearing bore with the elongated hole in proper position and narrow section facing out (except bores without oil holes install with bearing groove at the top). Be sure to start the bearing straight. Press the front bearing in flush with the outside end of the bearing bore. Press the rear bearing in flush with the bottom of counterbore which receives the expansion plug.

CRANKSHAFT

See that the oil passages of the crankshaft are clean and free of obstructions. These oil passages conduct oil from the main bearing journals to the connecting rod journals. If the bearing journals become worn out of round or scored, refinish to use undersize bearings. If either oil seal contact surface becomes grooved or scored, refinish and polish smooth.

When installing the rear bearing plate, use sufficient gaskets to provide crankshaft end play. See Table of Clearances. Use care not to damage the oil seal during the bearing plate installation.

CAMSHAFT

If a lobe of the camshaft has become slightly scored (too close tappet adjustment sometimes causes this), dress smooth with a fine stone. A badly worn or scored camshaft must be replaced with a new one.

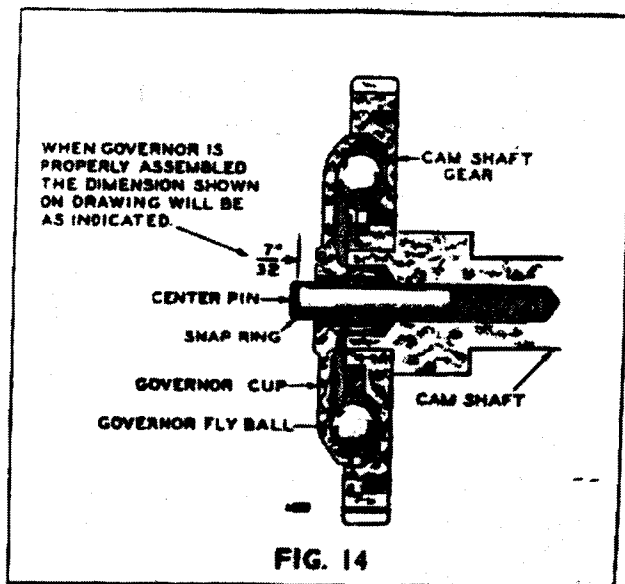
The camshaft center pin cannot be pulled outward nor removed without damage. The center pin is a very tight fit, and the 3/4-inch distance it extends beyond the end of the camshaft is quite critical. For this reason, never press or tap on the center pin, except as directed in the GOVERNOR CUP paragraph.

GOVERNOR CUP

The governor cup can be removed from the camshaft and gear after first removing the small snap ring from the camshaft center pin. Slide the governor cup forward over the

center pin, catching the governor fly balls in the hand.

Replace any fly ball which is grooved or has a flat spot. If the ball spacer arms are worn or otherwise damaged, or if the fly ball contact surface of the cup is grooved or rough. The governor cup must be a free spinning fit on the camshaft center pin, but without any excessive looseness or wobble.



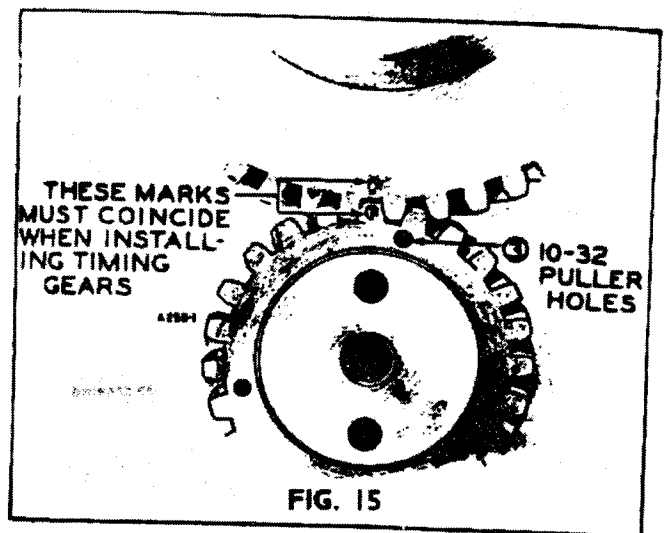
When assembling the governor cup to the camshaft and gear, be sure all twelve fly balls are installed in the spacer openings. After installing the snap ring to the center pin, hold the governor cup in toward the gear. The distance from the snap ring to the front surface of the governor cup must be $7/32$ " (Fig. 14). If the distance is more than $7/32$ "-inch, use an arbor press to carefully press the center pin in the required amount. If the distance is less than $7/32$ ", it will be necessary to remove the center pin and install a new one, pressing in only the required amount. The metal-lined hole of the governor cup must engage with the gear cover roll pin.

CAMSHAFT GEAR

The camshaft gear is keyed and pressed on to the camshaft. If replacement becomes necessary, the gear can be pressed off the camshaft. After removing the governor cup, fly balls, spacer, etc., use a hollow tool or pipe of the proper diameter to fit inside the gear bore and over the camshaft center pin. Press the camshaft out of the gear bore, taking extreme care not to press on the camshaft center pin.

When installing a camshaft gear to the camshaft, be sure the key is properly in place, and press on up to the camshaft shoulder. Assemble the governor ball spacer, balls, cup, etc. before installing to the engine.

When installing to the engine, be sure the marked tooth meshes with the marked tooth of the crankshaft gear, Fig. 15. Do not omit the thrust washer behind the camshaft gear.



CRANKSHAFT GEAR

The crankshaft gear is keyed drive fit to the crankshaft and is fastened with a lock ring. To remove the slotted gear (earlier type), use a claw type puller. To remove the gear which has three #10-32 tapped holes on a $2-1/2$ " diameter (later type), use a screw-attaching type gear puller.

When installing a crankshaft gear, see that its key is in place, face with the "O" timing mark outward, and drive the gear on up to the crankshaft shoulder. Be sure the marked tooth ("O" timing mark) meshes with the marked camshaft gear tooth.

OIL PUMP

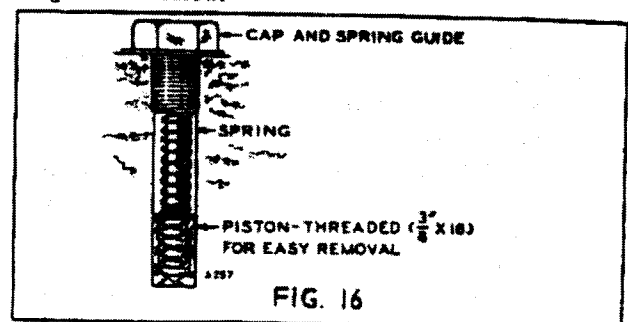
If the oil pump is to be removed, it must be turned off the oil intake pipe. If the oil pump fails to function properly, install a complete new pump. Except for the intake assembly, component parts of the oil pump are not available separately.

When installing the oil pump, be sure its mounting gasket is in good condition, and properly in place. Turn the intake pipe and cup in tightly and at the correct angle to have the intake cup parallel to the bottom of the crankcase.

NOTE: Be sure the oil pump is primed with oil.

OIL PRESSURE RELIEF VALVE

The oil pressure relief valve is not adjustable. If the valve should become stuck open or closed, remove and clean. Remove the hex head screw and copper washer, Fig. 16. Lift out the pressure spring. The valve can be removed with a long $3/8$ "-16 screw.



FLYWHEEL

The flywheel is keyed and a taper fit to the crankshaft. After removing the flywheel attaching screw, if the flywheel proves difficult to remove, re-install the flywheel screw and leave it a few turns loose. Hit the screw sharply to jar the flywheel loose.

When installing the flywheel, be sure the key is in good condition and is properly fitted in place. See that the taper surfaces of the crankshaft and of the flywheel are clean and free of nicks. The flywheel must run true. Any unbalance will set up harmful vibration. Tighten the mounting screw securely, to a torque wrench reading of 35 - 40 lb. ft.

OIL SEALS

Install the rear bearing plate oil seal flush with the outer surface of the plate. Install the gear cover oil seal flush with the outer edge of the oil seal opening. Both seals must be installed with the open side of the seal facing inward.

GENERATOR

GENERAL

The generator normally requires little maintenance other than the regular PERIODIC SERVICE operations, which should never be neglected. Some generator tests are simple to perform, do not require major disassembly, and require only a continuity test lamp set. Other tests require special equipment and extensive disassembly of the generator. Partial disassembly, and removal of the generator is necessary in order to make certain engine repairs.

GENERATOR REMOVAL

To disassemble the generator for removal, first remove the brush springs and brushes. Disconnect field coil and other lead wires which connect to the brush rig, to permit removal of the end bell and brush rig as an assembly. Be sure to tag each wire and its connection point as it is disconnected, to assure correct reconnection.

After removing the end bell mounting screws, carefully tap the end bell straight backward until it becomes free of the armature bearing. Place blocking under the rear of the engine, remove the screws which attach the generator frame to the engine rear, and carefully pull the frame assembly straight back over the armature. Use care not to allow the frame to drag or catch on the armature laminations.

To remove the armature, carefully block up the armature and remove the screws mounting its drive disc to the engine flywheel. Slide the armature away from the engine.

COMMUTATOR AND COLLECTOR RINGS

The mica insulation between the commutator bars, or segments, was originally undercut to a depth of 1/32-inch below the commutator surface. After a long period of service, the surface of the commutator may become worn down level with the mica. This condition would cause noisy brushes, sparking of the brushes, and pitting of the commutator. The mica

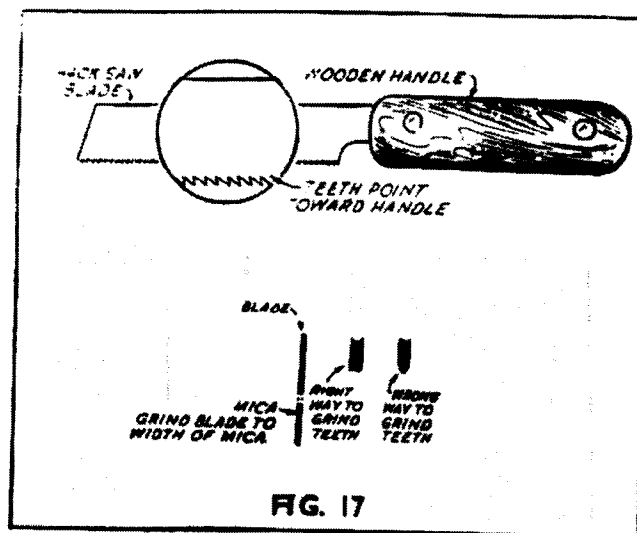


FIG. 17

should again be undercut to 1/32-inch depth. Remove the brush springs and pull all the brushes out of their guides. After tagging any leads disconnected (to assure correct reconnection) remove the end bell. With a mica undercutting tool, or an improvised tool fashioned from a back saw blade (Fig. 17), carefully cut the mica between all of the commutator bars down to the 1/32-inch depth. Use care to avoid scratching the surface. Remove any burrs which may be formed along the edges of the bars, and clean all spaces between bars completely free of any metallic particles, Fig. 18.

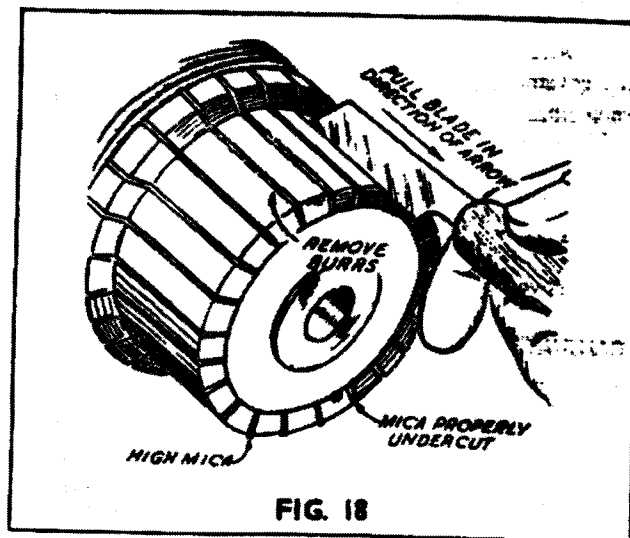


FIG. 18

If some unusual operating condition should cause the surface of the commutator or collector rings to become grooved, out of round, pitted, or rough, it will be necessary to remove the armature and turn the damaged commutator or collector rings in a lathe, to "true" the surface. Before centering the armature in the lathe, remove the ball bearing to prevent getting any dirt into it. After turning smooth, be sure to undercut the commutator mica as previously described. When the armature is re-installed, reduce the runout at the bearing end as much as possible before installing the end bell.

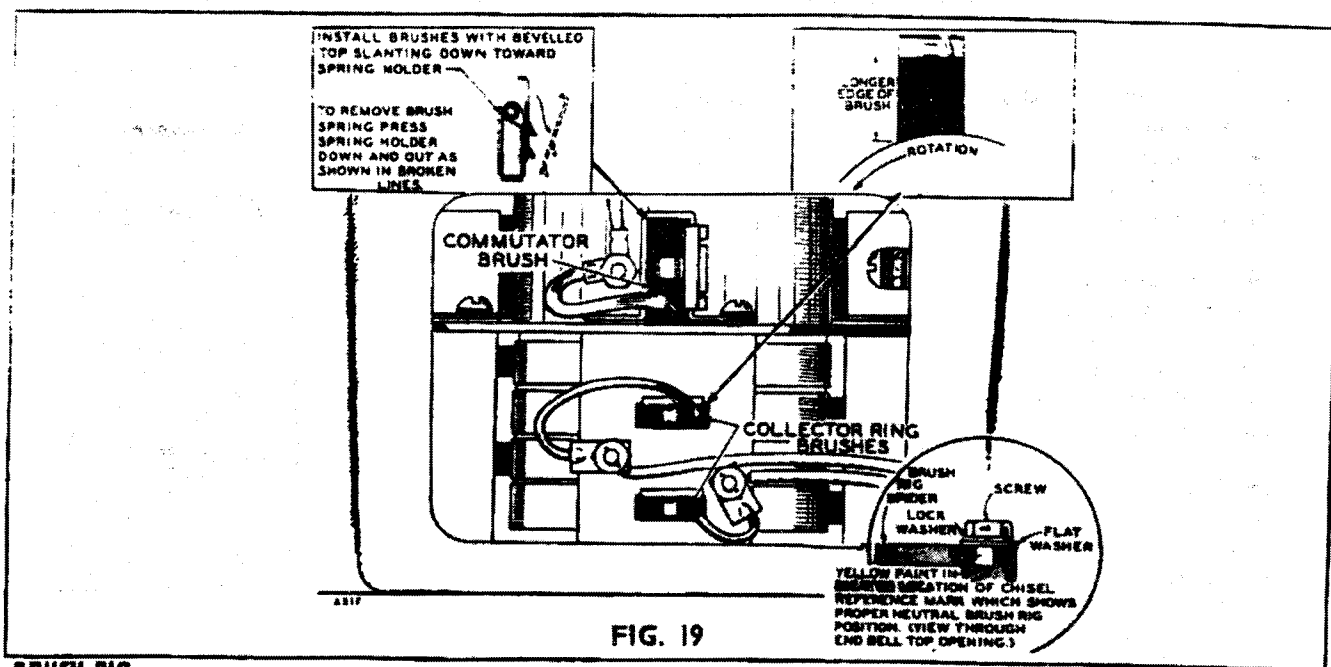


FIG. 19

BRUSH RIG

It is not necessary to loosen or remove the brush rig from the end bell for average generator servicing. However, if the brush rig has been loosened or removed for any reason, the brush rig must be returned to its exact original position. This original position was marked at the factory in the test run and must be maintained as long as the original brush rig and armature are continued in service. The position can be identified by a mark across the outer edge of the brush rig supporting ring. This mark must align with the marked support in the end bell (Fig. 19). Improper positioning of the brush rig will cause excessive arcing of the brushes, burning of the commutator, low generator output, and possible serious damage to the generator windings from over-heating.

Brushes eventually wear too short to perform their function. Brush wear will be more rapid under dusty operating conditions. Replace brushes when worn to 1/2-inch in length. The brush springs provide equal pressure as the brushes wear shorter in use. Each spring is permanently attached to a metal plate which snaps into place. To replace a commutator brush, first remove the spring by pushing the spring plate inward and away from the brush guide, Fig. 19. To replace a collector ring brush, first remove the spring by pulling straight outward on the spring plate. When inserting a new brush in its guide, be sure that the shorter length of the brush is installed against generator rotation, to conform to its off-set position for correct seating. Be sure that each brush is free in its guide, and that its spring is correctly installed. Keep the brush rig and end bell clean of carbon dust, etc.

GENERATOR BEARING

Single Shield Type has exposed ball bearings and should be lubricated. The generator bearing was lubricated at the factory with a lithium base grease meeting military specification MIL-G-10924. Unless dirt has gained entrance to the

bearing, no further lubrication of the bearing should be necessary for 2 years, or 5,000 operating hours. If dirt has gotten into the bearing, remove the bearing, clean thoroughly in a good solvent, dry, and relubricate according to the type of lubricant used.

If lithium base grease is used, fill only a 1/4-section of the bearing with grease, with no excess or reserve in the bearing recess or cover.

If standard ball bearing grease is used, fill a 1/2-section of the bearing with grease. Fill the bearing recess and cover 1/2-full. When using a grease other than lithium base, relubricate the bearing every six months or approximately 1200 operating hours.

GENERATOR BEARING

Double Shield Type has bearings sealed and does not require lubrication.

GENERATOR WINDINGS TEST PROCEDURE

Some generator tests do not require complete disassembly of the generator, and can be performed with the use of a continuity type test lamp set. Other tests require extensive generator disassembly and the use of an armature growler or other equipment usually found only in an electrical repair shop.

NOTE: Individual coils of the field coil set can be installed. Full instructions for installation are included with replacement coils, and must be carefully followed. Proper installation of individual coils can best be done by a qualified service shop.

It is seldom practicable to make internal repairs of generator windings. However, an external lead wire can be repaired as necessary.

FIELD COIL TESTS

To test the field coils for an open circuit or a grounded circuit, use a test lamp set. As each lead wire is disconnected, tag it and its connection point, to assure correct reconnection.

If the plant is an electric cranking model which uses the generator as a cranking motor, the field coils are wound with two separate windings to each coil. The series (cranking) winding is of very heavy wire and its leads, marked S1 and F+, are easily identified. The shunt field leads are marked F- and F+. Temporarily connect the two F+ leads together for test purposes. Manual cranking models have only the F- and F+ shunt field leads.

OPEN CIRCUIT TEST

To test for an open circuit, connect one test lamp lead to the F+ coil terminals, and the other test lamp lead to the F- coil lead. If the test lamp fails to light, an open circuit in the shunt winding is indicated. Repeat the test, between the S1 and F+ terminals. If the test lamp fails to light an open circuit in the cranking winding is indicated.

If an indicated open circuit cannot be isolated in an external lead, or in a loose terminal, a more thorough test of individual coils will be necessary. Consult a qualified service shop.

GROUNDING CIRCUIT TEST

To test the field windings for a grounded circuit, connect one test lamp lead to a bare metal part of the generator frame. Connect the other test lead to the coil terminals F+. If the test lamp lights, a grounded circuit is indicated. If inspection locates the ground in an external lead, repair as necessary. To locate a grounded coil, remove the screws mounting one of the pole shoes to the generating frame. Push the pole shoe and coil away from contact with the frame. If the ground is thus eliminated (test light goes out), the ground has been isolated at the loosened coil. Repeat as necessary until the grounded coil is located. Usually, the grounded point of the coil can be easily identified and the insulation repaired at the point of damage.

SHORT CIRCUIT TEST

A short circuit test requires the use of special equipment and testing of individual coils. A sensitive ohmmeter can be used to test the resistance of each coil winding. If one coil winding shows an ohmmeter reading of more than 10% LESS than the average reading of the other three coils, that coil is short circuited. On electric cranking models, care must be taken not to confuse the cranking winding with the shunt winding.

ARMATURE TESTS

The armature is wound with two separate windings, dc and ac. The dc winding produces direct current for exciting the field, and for charging the starting batteries on the electric cranking models. The ac winding produces the alternating current output of the generator. Replace a defective armature with a new one.

GROUNDING CIRCUIT TEST

Use a test lamp set to test both armature windings for a grounded circuit. Connect one test lamp lead to a bare metal point on the armature shaft. Contact the other test lead to the commutator surface. If the test lamp glows, the dc portion of the armature is grounded. Repeat the test, contacting the collector rings. If the test lamp glows, the ac portion of the armature is grounded. Replace a grounded armature with a new one.

AC WINDING, OPEN CIRCUIT TEST

Use a test lamp set to test the ac winding for an open circuit. If the generator is the 120/240-volt, single phase model there are TWO ac windings. Contact the test lamp leads to the two collector rings nearest the ball bearing. If the test lamp fails to light, an open circuit in that winding is indicated. Repeat the test in the same manner, contacting the two collector rings nearest the commutator. If the test is made between the two middle collector rings, the test lamp should not glow - if it does, a short circuit between the two windings is indicated.

If the generator is a 3-phase, 3-wire model, contact one test lead to the collector ring nearest the commutator (no winding is connected to the ring next to the bearing). Contact the other test lead to the next two collector rings, in turn. If the test lamp fails to light on either test, an open circuit is indicated.

If the generator is a 3-phase, 4-wire model, contact one test lead to the collector ring nearest the bearing. Contact the second test lead to each of the next 3 collector rings, in turn. If the test lamp fails to light on any of the 3 tests, an open circuit is indicated.

AC WINDING, SHORT CIRCUIT TEST

An armature growler is required for making an ac winding short circuit test. Follow the test procedure recommended by the growler manufacturer.

DC WINDING, OPEN OR SHORT CIRCUIT TEST

An armature growler is required to make a satisfactory test. Follow the test procedure recommended by the growler manufacturer.

SHORT BETWEEN AC AND DC WINDINGS

Place one test prod on the commutator, and the second test prod on one of the slip rings. If the test light glows, a short circuit between the ac and dc windings is indicated.

CONTROL BOX EQUIPMENT

The control box equipment requires no maintenance other than keeping it dry, clean, and all connections electrically tight. If any of the control box equipment fails to function properly, replace the defective parts with a corresponding new part. Repairs or adjustments on such parts are seldom practicable.

Always disconnect the starting battery before working on any control box equipment. Tag or otherwise mark each lead

and its connection point before disconnecting it, to assure correct reconnection. Check carefully for loose or broken connections, or for damaged insulation.

MAGNET USE PLANT

These supplementary instructions apply to the Onan model 10CW - 150R direct current generating plants, which are designed especially for industrial magnet service.

The 10CW-150R generating plant is rated at 10,000 watts, 250 volts, direct current. A separate automotive type battery charging generator and an automotive type starting motor are used, with a 6-volt battery to supply starting current.

The engine is basically the same as that used for alternating current plants. Disregarding information which obviously applies only to alternating current plants.

OPERATION

RHEOSTAT CONTROL

Be sure the field rheostat is turned to its maximum resistance position (minimum generator voltage) before starting the plant. After connecting the magnet by operating the magnet controller, adjust the rheostat to give a generator voltage of 250 volts, or to the rated voltage of the magnet. When first connected, the magnet resistance is comparatively low, so more rheostat resistance is needed to keep the voltage at the proper value. As the magnet warms up in use, its resistance increases and the rheostat must be re-adjusted to bring the voltage up to normal.

GENERAL

Follow the principles of operation as given for a basic alternating current plant.

PERIODIC SERVICE

Follow the schedule of servicing as given for a basic alternating current plant.

ADJUSTMENTS

GOVERNOR

The function of the governor is to keep the engine speed nearly constant under changing load conditions. The direct current generator operates at a higher speed (approximately 1980 rpm) than an alternating current plant (1800 rpm).

If governor adjustment becomes necessary, follow the procedure as outlined for an ac plant, except that engine speed instead of generator output cycles must be used for determining proper settings. Use an accurate tachometer or other speed checking instrument.

SPEED CHART FOR CHECKING GOVERNOR REGULATION

RPM LIMITS

MINIMUM	MAXIMUM
1900	2000

RECOMMENDED RPM SPREAD

FULL LOAD	NO LOAD
1960	2000

PENNSYLVANIA APPROVED STANDBY PLANTS

Certain models of the CW series have been awarded the Certificate of Approval by the Industrial Board of the Pennsylvania Department of Labor and Industry, Commonwealth of Pennsylvania. These plants meet the rigid requirements established and as contained in the *REGULATIONS FOR PROTECTION FROM FIRE AND PANIC*. These regulations apply both to the generating plant and to its installation requirements.

Most of the instructions for the standard plants will apply to the *Pennsylvania Approved* plants also.

MAINTENANCE DIAGNOSIS

POSSIBLE CAUSE

REMEDY

ENGINE CRANKS TOO STIFFLY

Too heavy oil in crankcase. Drain. Refill with light oil.

Engine stuck. Disassemble and repair.

ENGINE CRANKS TOO SLOWLY WHEN CRANKED ELECTRICALLY

Discharged or defective battery. Recharge or replace.

Loose connections. Tighten loose connections.

Corroded battery terminals. Clean corroded terminals.
Replace cable if necessary.

Brushes worn excessively or making poor contact. Replace brushes or clean commutator.

Short circuit in generator load circuit. Repair or replace parts necessary. Disconnect load.

Dirty or corroded points in start solenoid switch. Replace Switch.

ENGINE WILL NOT START WHEN CRANKED

Faulty ignition. Clean, adjust, or replace points, spark plugs, condenser, etc., or retune ignition.

Lack of fuel or faulty carburetion. Refill the tank. Check the fuel system. Clean, adjust, or replace parts necessary.

Cylinders flooded. Ground spark plug cables. Crank engine with spark plugs removed.

Poor fuel. Drain. Refill with good fuel.

Poor compression. Tighten cylinder heads and spark plugs. If still not corrected, grind the valves. Replace piston rings if necessary.

POSSIBLE CAUSE

REMEDY

Wrong ignition timing.

Reset breaker points or retune ignition. See IGNITION TIMING.

ENGINE RUNS BUT VOLTAGE DOES NOT BUILD UP

Poor brush contact.

See that brushes seat well on commutator and collector rings, are free in holders, are not worn shorter than 1/2-inch, and have good spring tension.

Open circuit, short circuit, or ground in generator.

Refer to the GENERATOR section of Maintenance.

VOLTAGE UNSTEADY BUT ENGINE NOT MISFIRING

Speed too low.

Adjust governor to correct speed.

Poor commutation or brush

Refinish commutator or undercut mica if necessary. See that brushes seat well on commutator and collector rings, are free in holders, are not worn shorter than 1/2-inch, and have good spring tension.

Loose connections.

Tighten connections.

Fluctuating load.

Correct any abnormal load condition causing trouble.

GENERATOR OVERHEATING

Short in load circuit.

Correct short circuit.

Generator overloaded.

Reduce the load.

Improper brush rig position.

Refer to the GENERATOR section of MAINTENANCE — See Brush Rig.

POSSIBLE CAUSE**REMEDY****ENGINE OVERHEATING**

Improper lubrication.	See Low Oil Pressure.
Poor ventilation.	Provide ample ventilation at all times.
Dirty or oily cooling surfaces.	Keep the engine clean.
Retarded ignition timing.	Retime ignition.
Generator overloaded.	Reduce load.

VOLTAGE DROPS UNDER HEAVY LOAD

Engine lacks power.	See remedies under "Engine Misfires at Heavy Load".
Poor compression.	Tighten cylinder heads and spark plugs. If still not corrected, grind the valves. Replace piston rings if necessary.
Faulty carburetion.	Check the fuel system. Clean, adjust or repair as needed.
Dirty carburetor air cleaner.	Clean and Service.
Choke partially closed.	Choke plate must be wide open at operating temperature.
Carbon in cylinders or in carburetor venturi.	Remove carbon.
Restricted exhaust line.	Clean or increase the size.
Improper governor adjustment.	Refer to ADJUSTMENTS.

ENGINE MISFIRES AT LIGHT LOAD

Carburetor idle jet clogged or improperly adjusted.	Clean or adjust.
Spark plug gaps too narrow.	Adjust to correct gap - .025" (.018" for gas operation).
Intake air leak.	Tighten manifold and carburetor mounting screws. Replace gaskets if necessary.
Faulty ignition.	Clean, adjust, or replace breaker points, spark plugs, condenser, etc.

POSSIBLE CAUSE**REMEDY****ENGINE MISFIRES AT HEAVY LOAD**

Defective spark plug.	Replace.
Faulty ignition.	Clean, adjust, or replace breaker points, spark plugs, condensers, etc. or retime ignition.
Clogged carburetor.	Clean carburetor.
Clogged fuel screen.	Clean.
Defective spark plug cable.	Replace.

ENGINE MISFIRES AT ALL LOADS

Fouled spark plug.	Clean and adjust.
Defective or wrong spark plug.	Replace.
Leaking valves.	See VALVE SERVICE.
Broken valve spring.	Replace.
Defective or improperly adjusted breaker points.	Adjust or replace breaker points.

LOW OIL PRESSURE

Oil too light.	Drain, refill with proper oil.
Oil badly diluted.	Drain, refill with proper oil.
Oil too low.	Add oil.
Oil relief valve not seating.	Remove and clean, or replace.
Badly worn bearings.	Replace.
Sludge on oil screen.	Remove and clean.
Badly worn oil pump.	Replace.
Defective oil pressure gauge.	Replace.

HIGH OIL PRESSURE

Oil too heavy.	Drain, refill with proper oil.
Clogged oil passage.	Clean all lines and passages.
Oil relief valve stuck.	Remove and clean.
Defective oil pressure gauge.	Replace.

<u>POSSIBLE CAUSE</u>	<u>REMEDY</u>
Lean fuel mixture.	Clean carburetor. Adjust jets.
Clogged fuel filter.	Clean.
Air leak at intake manifold or carburetor flange.	Tighten mounting screws. Replace gaskets if necessary.
Poor fuel.	Refill with good, fresh fuel.
Spark advanced too far.	Reset breaker points or re-time ignition.
Intake valve leaking.	Reseat or replace.

**EXCESSIVE OIL CONSUMPTION,
LIGHT BLUE EXHAUST**

Poor compression. Usually due to worn pistons, rings, or cylinders.	Refinish cylinders. Install oversize pistons and rings.
Oil too light or diluted.	Drain. Refill with proper oil.
Too large bearing clearance.	Replace bearings necessary.
Engine misfires.	Refer to "Engine Misfires at All Loads".
Faulty ignition.	Clean, adjust, or replace breaker points, spark plugs, condenser etc., or retime the ignition.
Too much oil.	Drain excess oil.

**BLACK, SMOKY EXHAUST, EXCESSIVE FUEL
CONSUMPTION, FOULING OF SPARK PLUGS WITH
BLACK SOOT, POSSIBLE LACK OF POWER
UNDER HEAVY LOAD.**

Fuel mixture too rich.	See that choke opens properly. Adjust jets properly. Adjust the float level.
Choke not fully open.	See that choke opens properly.
Dirty air cleaner.	Clean and Service.

<u>POSSIBLE CAUSE</u>	<u>REMEDY</u>
Loose connecting rod.	Replace rod bearings.
Low oil supply.	Add oil. Change if necessary.
Oil badly diluted.	Drain. Refill with proper oil.
Low oil pressure.	See Low Oil Pressure for remedies.

ENGINE STOPS UNEXPECTEDLY

Empty fuel tank.	Refill.
Defective ignition system.	Check the ignition system. Repair or replace as needed. See that the STOP button lead is not grounded.
Fuel pump failure.	Repair or replace.

**DULL METALLIC THUD, IF NOT BAD, MAY
DISAPPEAR AFTER FEW MINUTES OPERATION. IF
BAD, INCREASES WITH LOAD.**

Loose crankshaft bearing.	Replace, unless one of the next two remedies permanently corrects the trouble.
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**SHARP METALLIC THUD, ESPECIALLY WHEN
COLD ENGINE FIRST STARTED**

Low oil supply.	Add oil. Change if necessary.
Oil badly diluted.	Drain. Refill with proper oil.

**PINGING SOUND WHEN ENGINE IS SUDDENLY
OR HEAVILY LOADED**

Carbon in cylinders.	Remove the carbon.
Spark advanced too far.	Reset breaker points or re-time ignition.
Wrong spark plugs.	Install correct spark Plugs.
Spark plugs burned or carboned.	Clean. Install new plugs if necessary.
Valves hot.	Adjust tappet clearance. See VALVE SERVICE.
Fuel stale or low octane.	Use good, fresh fuel.
Lean fuel mixture.	Clean fuel system. Adjust carburetor jets properly.

POSSIBLE CAUSE**REMEDY****TAPPING SOUND**

Valve clearance too great. Adjust to proper clearance.
See VALVE TAPPETS.

Broken valve spring. Install new spring.

HOLLOW CLICKING SOUND WITH COOL ENGINE UNDER LOAD

Loose piston. If noise is only slight and disappears when engine warms up, no immediate attention needed. Otherwise replace parts necessary.

SHARP CLICK WHEN CRANKING ENGINE

Magneto impulse coupling. Normal condition — should stop as soon as engine starts.

VOLTAGE LOW AT FAR END OF LINE BUT NORMAL NEAR PLANT

Too small line wire used for load and distance. Install larger or extra wires or reduce load.

MOTORS RUN TOO SLOWLY AND OVERHEAT AT FAR END OF LINE BUT OK NEAR THE PLANT

Too small wire used for load. Install larger or extra wires or reduce load.

NOISY BRUSHES

High mica between bars of commutator. Undercut mica.

POSSIBLE CAUSE**REMEDY****EXCESSIVE ARCING OF BRUSHES**

Rough commutator or rings. Turn down.

Dirty commutator or rings. Clean.

Brushes not seating properly. Sand to a good seat or reduce load until worn in.

Open circuit in armature. Install a new armature.

Brush rig out of position. Line up properly.

SPARK PLUGS FOUL RAPIDLY

Engine running "cold". Restrict air flow. Install preheater hose.

Wrong plugs. Replace with correct plugs.

Carburetor too "rich". Adjust.

OIL DILUTION

One spark plug fouled. Clean plugs.

Leaky carburetor valve. Clean.

OIL SEAL LEAK

Worn oil seals. Replace.

Fouled breather valve. Clean or replace.

Loose oil fill cap. Tighten — replace if gasket is damaged.

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Journal of Management Studies, 2006; 43(7): 1198–1216

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- | Year | Percentage of population aged 15 and over employed in manufacturing |
|------|---|
| 1970 | 25 |
| 1975 | 28 |
| 1980 | 22 |
| 1985 | 22 |
| 1990 | 15 |

1. *Phragmites australis* (Cav.) Trin. ex Steud.

PARTS CATALOG

This catalog applies to the standard CW Plants (including mobile application plants) as listed below. Parts are arranged in groups of related items. Each illustrated part is identified by a reference number corresponding to the same reference number below the illustration. Parts illustrations are typical. Using the *Model and Spec. No.* from the plant nameplate, select the Parts Key No. (1, 2, etc., in the last column) that applies to your plant Model and Spec. No. This Parts Key No. represents parts that differ between models. Unless otherwise mentioned in the description, parts are interchangeable between models. Right and left plant sides are determined by facing the engine end (front) of the plant.

PLANT DATA TABLE

MODEL & SPEC. NO.	ELECTRICAL DATA					PARTS KEY NO.
	WATTS	VOLTS**	CYCLE	PHASE	WIRES	
5CW-1M/	5,000	120	60	1	2	1
5CW-2M/	5,000	240	60	1	2	1
5CW-3M/	5,000	120/240	60	1	3	1
5CW-4M/	5,000	120/208	60	3	4	1
5CW-5M/	5,000	240	60	3	3	1
5CW-1R/	5,000	120	60	1	2	2
5CW-2R/	5,000	240	60	1	2	2
5CW-3R/	5,000	120/240	60	1	3	2
5CW-4R/	5,000	120/208	60	3	4	2
5CW-5R/	5,000	240	60	3	3	2
5CW-6R/	5,000	480	60	3	3	2
5CW-7R/	5,000	220/380	60	3	4	2
5CW-8R/	5,000	127/220	60	3	4	2
5CW-53M/	5,000	120/240	50	1	3	1
5CW-54M/	5,000	120/208	50	3	4	1
5CW-57M/	5,000	220/380	50	3	4	1
5CW-53R/	5,000	120/240	50	1	3	2
5CW-54R/	5,000	120/208	50	3	4	2
5CW-55R/	5,000	240	50	3	3	2
5CW-57R/	5,000	220/380	50	3	4	2
6CW-53R/	6,250	120/240	50	1	3	4
6CW-54R/	6,250	120/208	50	3	4	4
6CW-55R/	6,250	240	50	3	3	4
6CW-55DR/	6,250	120/240	50	3	4	4
6CW-56R/	6,250	480	50	3	3	4
6CW-57R/	6,250	220/380	50	3	4	4
705CW-1R/	7,500	120	60	1	2	4
705CW-2R/	7,500	240	60	1	2	4
705CW-3R/	7,500	120/240	60	1	3	4
705CW-3R17/	7,500	120/240	60	1	3	4
705CW-4R/	7,500	120/208	60	3	4	4
705CW-5R/	7,500	240	60	3	3	4
705CW-5DR/	7,500	120/240	60	3	4	4
705CW-6R/	7,500	480	60	3	3	4
705CW-7R/	7,500	220/380	60	3	4	4
8CW-3R/	8,000	120/240	50	1	3	4
8CW-4R/	8,000	120/208	50	3	4	4
8CW-53M/	8,000	120/240	50	1	3	3
8CW-54M/	8,000	120/208	50	3	4	3
8CW-55M/	8,000	240	50	3	3	3
8CW-56M/	8,000	480	50	3	3	3
8CW-57M/	8,000	220/380	50	3	4	3
8CW-53R/	8,000	120/240	50	1	3	4
8CW-54R/	8,000	120/208	50	3	4	4
8CW-55R/	8,000	240	50	3	3	4
8CW-55DR/	8,000	120/240	50	3	4	4
8CW-56R/	8,000	480	50	3	3	4
8CW-57R/	8,000	220/380	50	3	4	4
9CW-3R/	9,000	120/240	60	1	3	4
9CW-4R/	9,000	120/208	60	3	4	4
10CW-1M/	10,000	120/240	60	1	3	3
10CW-4M/	10,000	120/208	60	3	4	3
10CW-5M/	10,000	240	60	3	3	3
10CW-6M/	10,000	480	60	3	3	3

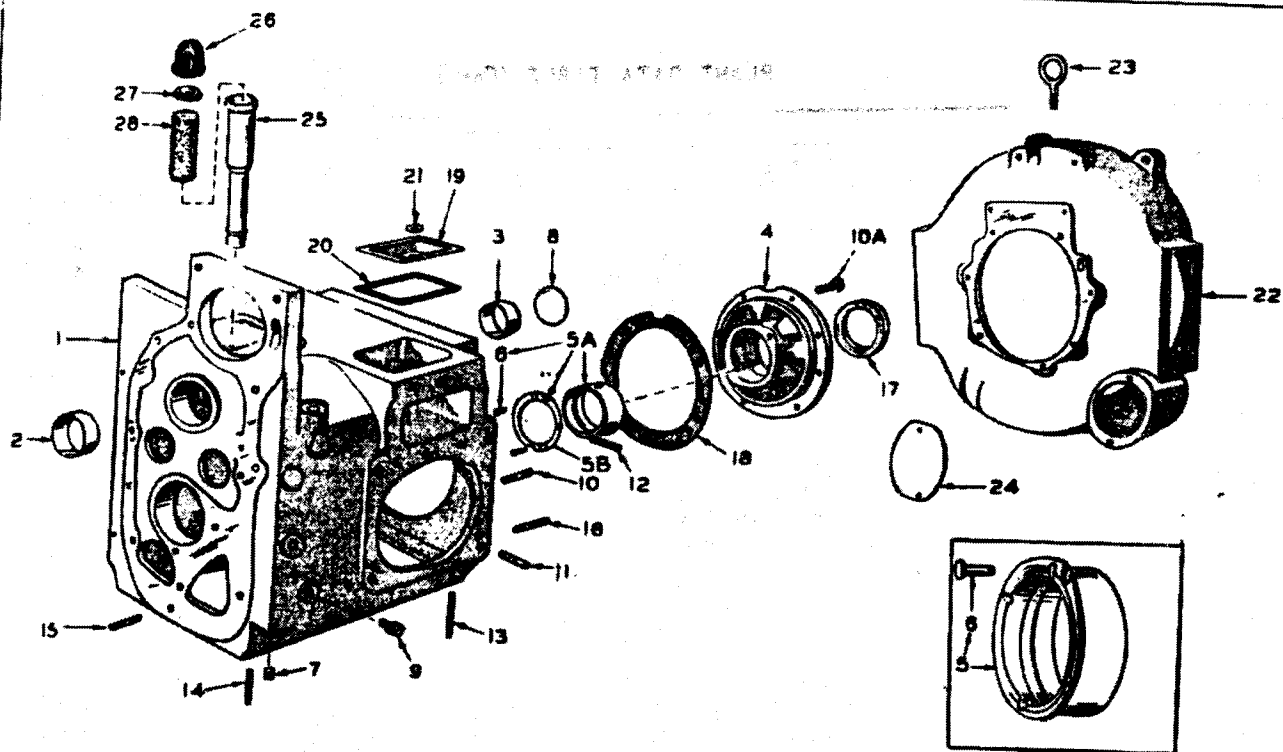
PLANT DATA TABLE (Cont.)

MODEL & SPEC. NO.	ELECTRICAL DATA					PARTS KEY NO.
	WATTS	VOLTS**	CYCLE	PHASE	WIRES	
10CW-3R/	10,000	120/240	60	1	3	4
10CW-4R/	10,000	120/208	60	3	4	4
10CW-5R/	10,000	240	60	3	3	4
10CW-5DR/	10,000	120/240	60	3	4	4
10CW-6R/	10,000	480	60	3	3	4
10CW7R/	10,000	220/380	60	3	4	4
10CW-8R/	10,000	127/220	60	3	4	4
10CW-150R/	10,000	250	DC		2	5
MOBILE APPLICATION PLANTS ***	SPECIFICATION NUMBERS, 96, 665, 980, 1329, 1338, 1511, 1597, 1615, 1689, 1725, 1775, 1776, 1813, 1819, 1824, 1837, 1841, 1850, 1970, 1991, 2148, 2203, 2206, 2217, 2428, 2537					6

* - The Specification Letter Advances (A to B, B to C, etc.) with Manufacturing Changes.

** - Reference to 120, 240, 120/240 and 480-volt Also Applies to 115, 230, 115/230 and 460-volt.

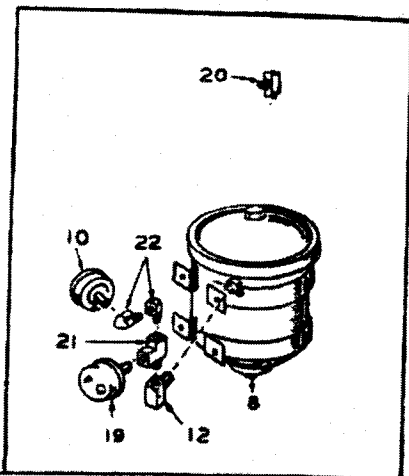
*** - Parts that Differ Between Mobile Application Plants will Also have the Specification Number Shown in the Part Description.



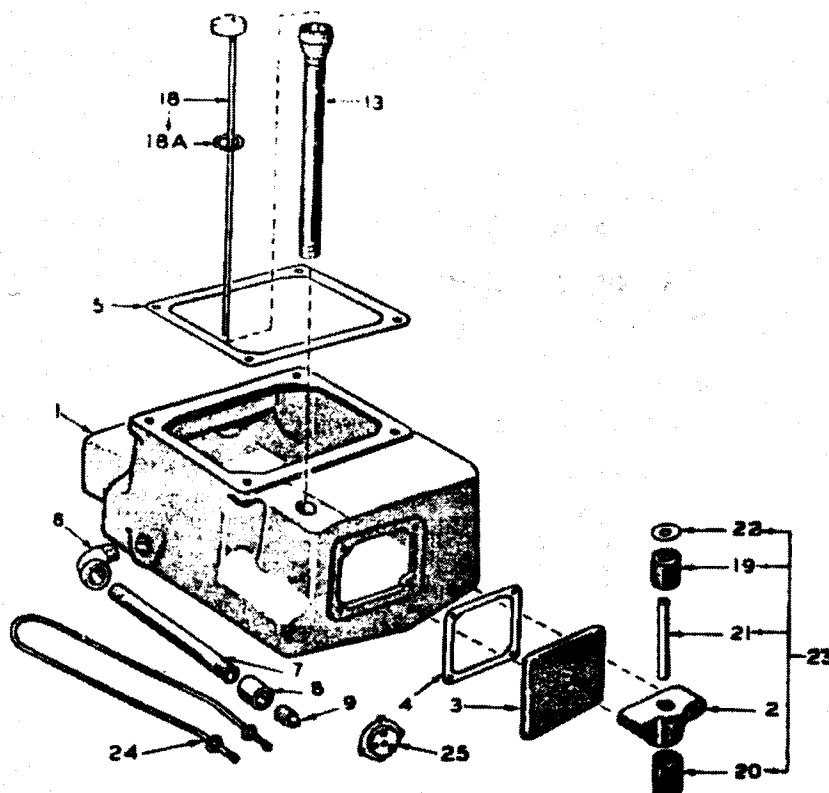
CRANKCASE GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	101A236	1	Crankcase. (Incl. Brgs., Rr. Brg. Plate & Oil Seal) - Repl. 101A217
2	101B373	1	Bearing, Frt. Cam., Prec. Type (Repl. 101A70)
3	101A367	1	Bearing, Rr. Cam., Prec. Type (Repl. 101A50)
4	PLATE, REAR CRANKSHAFT BRG.		
	101C67	1	To Spec. E
	101C268	1	Begin Spec. E
5		2	Bearing Kit, Crankshaft, Frt. & Rr. - To Spec. J, See Ref. No. 5A
5A	101K341	2	Bearing Kit, Crankshaft - Frt. & Rr., Incl. Thrust Washer & Pins, Prec. Type, Bronze Faced, Specify: Std. or .002", .010", .020" or .030" Under., Original Equip. Begin Spec. J Repl. Alum. Flanged Brg. Kit 101K220 Used on Earlier Models
5B	104B432	2	Washer, Crankshaft Thrust
6	516A72	As Req.	Pin, Lock (2) Flanged Brg., (4) Separate Thrust Washers
7	505-274	4	Plug, Countersunk Hd.
8	517-48	1	Plug, Exp., Rr. Camshaft Brg. Opening (Repl. 517-1B)
9	502-2	2	Elbow, Oil Filter Lines
10	520A11	8	Stud, Rear Brg. Plate, To Spec. E

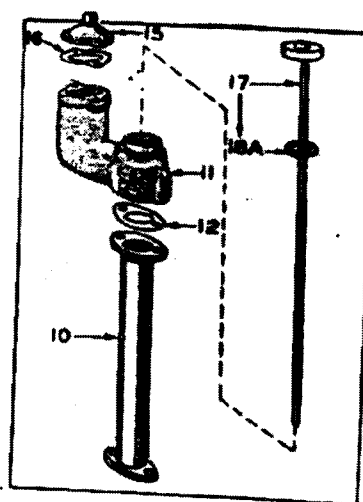
REF. NO.	PART NO.	QTY. USED	PARTS DESCRIPTION
X 10A	805-18	8	Bolt, Place, Rear Brg. Plate Begin Spec. E
X 11	520A431	8	Stud, Cyl. Base
X 12	520A434	2	Stud, Cyl. Base
X 13	520A432	2	Stud, Oil Base, Spec. A
X 14	520A433	2	Stud, Oil Base, Spec. A
X 15	STUD, GEAR COVER		
	520A9	6	Spec. A
	520A11	1	Begin Spec. B
X 16	520A118	6	Stud, Flywhl. Hsg., Spec. A
X 17	509P64	1	Seal, Oil, Crankshaft Rear
X 18	101K116	1	Gasket Kit, Rr. Brg. Plate (Assorted Thickness)
X 19	110B640	2	Cover, Valve Box
X 20	110A647	2	Gasket, Valve Box Cover
21	526-63	2	Washer, Copper - Valve Cover Screw
22	HOUSING, FLYWHEEL		
	101E188	1	Spec. A Only
	101E222	1	Key 1,2,3,4,6 - Begin Spec. B
	101B229	1	Key 5
23	403A95	1	Bolt, Eye - Lifting
24	101A154	1	Plate, Cover, Flywhl. Hsg. Opening, Spec. A
25	123A445	1	Tube, Breather - Begin Spec. B
X 26	123A458	1	Cap, Breather Tube - Begin Spec. B
X 27	123A315	1	Valve, Breather
X 28	123-452	1	Filter, Breather Tube - Begin Spec. B



<u>QTY.</u>	<u>PART NO.</u>	<u>REF. NO.</u>	<u>PARTS DESCRIPTION</u>
2	502-3	14	Connector, Inv. Flare - Lines to Filter
1	122B94	15	Line, Filter Inlet
1	122B95	16	Line, Filter Outlet
1	120A182	17	Screw, Shoulder - Pump Mtg.
2	502-2	18	Elbow, Inv. Flare, Filter Lines, Key 1,2,3,4,5
1	309B10	19	Switch, Cut-off - Low Oil Press. (Opt.) Key 6
1	308-97	20	Switch, Momentary Contact (Used with Opt. Cut-off Switch) Repl. 308P37, Key 6
1	502-58	21	Tee, (Opt.) Cut-off Switch Mtg. Key 6
2	502-20	22	Elbow, St. (Two Used to Mt. Oil Gage Optionally Facing Left Key 6



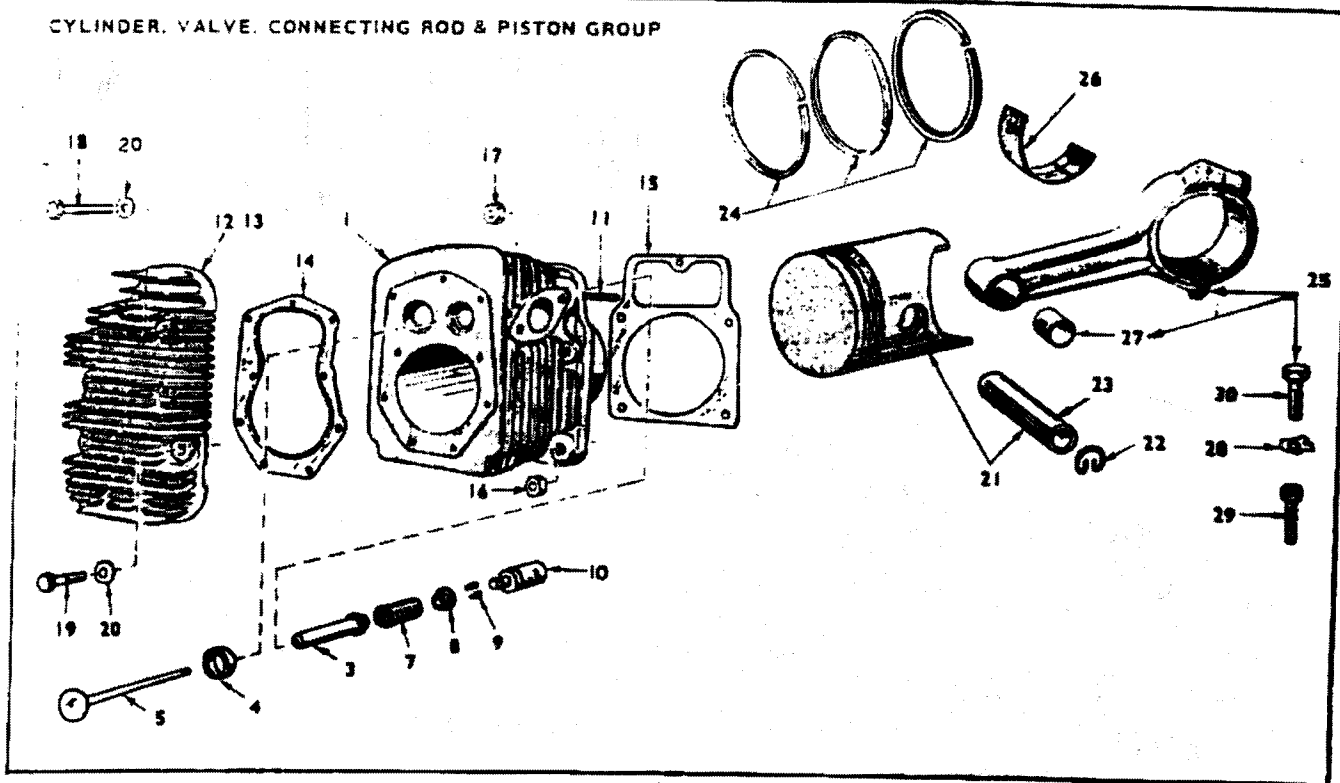
OIL BASE GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	BASE, OIL		
	102E220	1	Spec. A, Key 1,2,3,4,5
	102E262	1	Begin Spec. B, Key 1,2,3,4,5 & 6 (Except Spec. 2428)
	102E465	1	Key 6 (Spec. 2428 Only)
2	FOOT, OIL BASE		
	102B223	2	Spec. A
	102B271	2	Begin Spec. B
3	COVER, OIL BASE OPENING		
	102A221	1	Standard
	102A248	1	Optional - For Heater Assy, Less Heater
4	102A222	1	Gasket, Oil Base Opening Cover
5	102B215	1	Gasket, Oil Base to Crkcase.
6	505-51	1	Elbow, St. - Oil Base Drain (3/4")
7	505-268	1	Pipe, Oil Drain (3/4 x 9)
8	505-29	1	Coupling, Drain Pipe, 3/4"
9	505-130	1	Plug, Oil Drain - 3/4"
10	123C402	1	Tube, Oil Fill - Spec. A Only
11	123C388	1	Housing, Crankcase Breather-Spec. A Only
12	123A380	2	Gasket - Oil Fill Tube, Breather Hsg., Spec. A Only

REF. NO.	PARTS NO.	QTY. USED	PARTS DESCRIPTION
13	123A437	1	Tube, Oil Fill - Begin Spec. B
15	123B409	1	Cap, Breather Hsg., Spec. A Only
16	123A410	1	Gasket, Breather Hsg., Spec. A Only
17	123A378	1	Indicator, Oil Level - Spec. A Only
18	123A439	1	Indicator, Oil Level - Begin Spec. B
18A	123A191	1	Gasket, Oil Level Indicator
19	402A36	4	Cushion, Mtg. - Upper
20	402A38	4	Cushion, Mtg. - Lower
21	402A46	4	Bushing, Cushion Spacer
22	526A124	8	Washer, Mtg. Cushion
23	MOUNTING ASSY. - INCL. REF. 19,20,21,22 PLUS HARDWARE		
	402A103	4	With 6" Bolt
	402A219	4	With 8" Bolt (Optional)
24	333B42	1	Element, Heater - Oil Base (Opt.)
25	309-29	1	Thermostat - Oil Heater Cont. (Opt.)

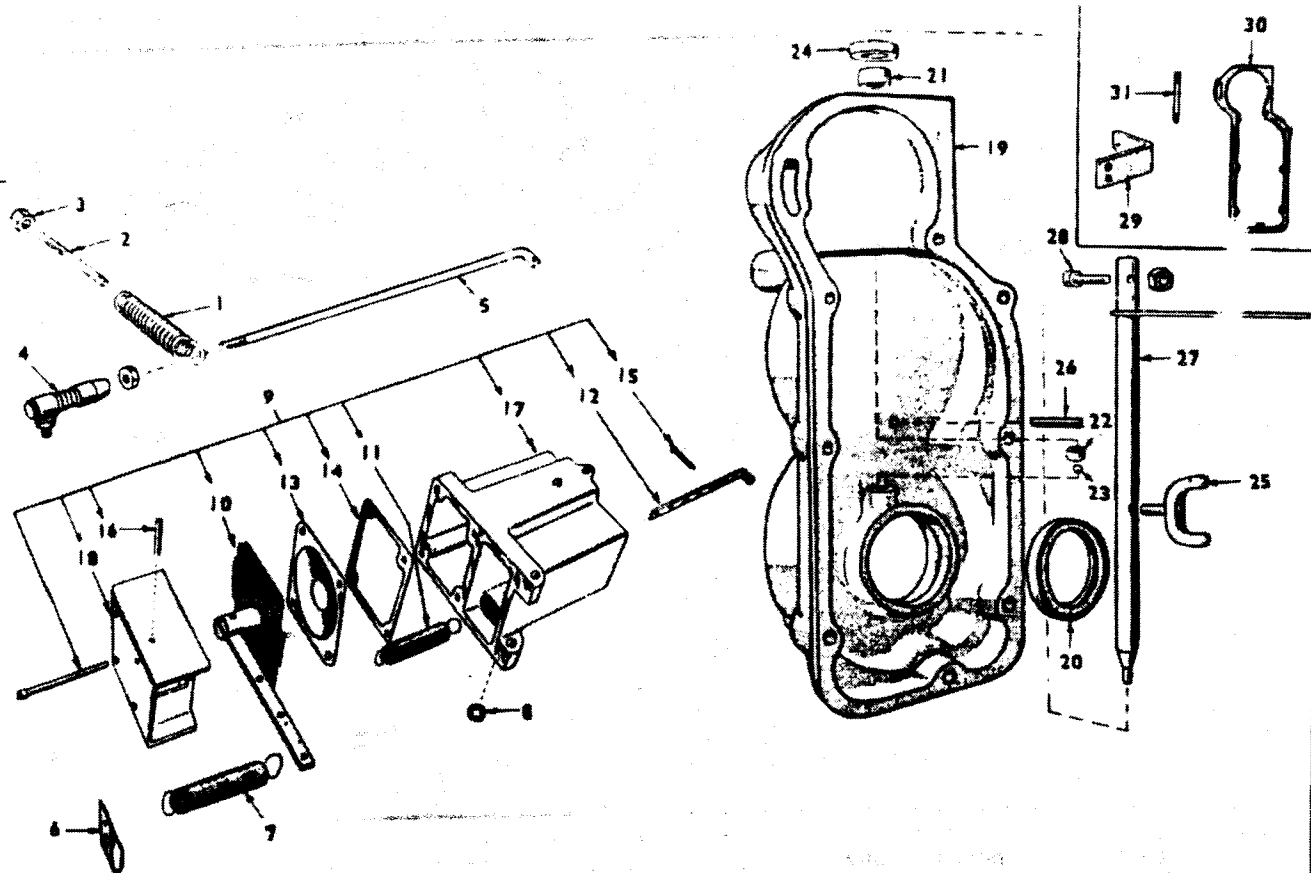
CYLINDER, VALVE, CONNECTING ROD & PISTON GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	BLOCK, CYL. - INCL. VALVE GUIDES & EXH. VALVE SEAT INSERT - LESS VALVES, ETC.		
	110C757	1	Left Hand, Std.
	110C1201	1	Left Hand with Stellite Intake & Exhaust Valve Seat Inserts - Optional
	110C756	1	Right Hand, Std.
	110C1200	1	Right Hand, with Stellite Intake & Exhaust Valve Seat Inserts - Optional
3	110B644	4	Guide, Valve
4	INSERT, VALVE SEAT - STELLITE		
	110A646	2	Exhaust - Specify: Std. or .002", .005", .010", .025" Over.
	110A1191	2	Intake - Optional
5	VALVE		
	110B642	2	Exhaust - Stellite - Std.
	110B1195	2	*Exhaust - Stellite - For Rotator - Optional
	110B643	2	Intake - Std.
	110B1193	2	*Intake - Stellite - Optional
7	110A738	4	Spring, Valve
8	RETAINER, VALVE SPRING		
	110A648	4	Used with 110B642 & 110B643 Valves
	110A1204	4	*Used with 110B1193 & 110B1195 Valves - Optional
8	110A620	4	*Rotocap, Valve - Used with 110B1193 & 110B1195 Valves - Optional
9	110A639	8	Lock, Valve Sprg. Retainer
10	115A34	4	Tappet, Valve - Incl. Adj. Screw
11	520A11	4	Stud, Exhaust Manifold
12, 13	HEAD, CYL. - (Be Sure Both Heads are of the Same Compression)		
12	110D638	1	Left Hand, Std. Comp., For Gasoline Fuel
12	110D749	1	Left Hand, High Comp. For Gas Fuel

REF. NO.	PART NO.	QTY. USED	PARTS DESCRIPTION
13	110D637	1	Right Hand, Std. Comp., For Gasoline Fuel
13	110D748	1	Right Hand, High Comp., For Gas Fuel
X14	110B641	2	Gasket, Cyl. Hd.
N15	110B645	2	Gasket, Cyl. Base
N16	110A707	8	Nut, Cyl. Base Mtg.
N17	104A91	2	Nut, Cyl. Base Mtg.
X18	110A815	10	Screw, Hex. Hd. Cyl. Hd. Mtg.
X19	110A814	8	Screw, Hex Hd. Cyl. Hd. Mtg.
20	526A127	18	Washer, Cyl. Hd. Mtg.
21	112-90	2	Piston & Pin - Specify: Std. or .010", .020", .030" or .040" Over. (Repl. 112-55)
22	112A19	4	Ring, Lock - Piston Pin
23	112A54	2	Pin, Piston - Specify: Std. or .010", .020", .030" or .040" Over. (Repl. 113-59)
X24	113-105	2	Ring Set - For 1 Piston - Specify: Std. or .010", .020", .030", .040" Over. (Repl. 113-59)
X25	114B64	2	Rod, Connecting
X26	114B53	4	Bearing Half, Con. Rod - Specify: Std. or .002", .010", .020", .030" Under.
27	114B54	2	Bushing, Piston Pin - Semi-Finished
X28	114A20	4	Washer, Lock - Con. Rod Screw - (See Ref. 30)
29	114A57	4	Screw, Conn. Rod - (See Ref. 30)
30	805-20	4	Bolt, Place - Repl. 114A20 & 114A57

* - The optional Stellite Valve has its groove located 1/4" from end of stem to accommodate optional Rotocap Valve Rotators and not change spring tension. If the Rotocap is not used on this valve, the optional 110A1204 Spring Retainer (13 64" thick at O.D.) is required for proper spring tension.

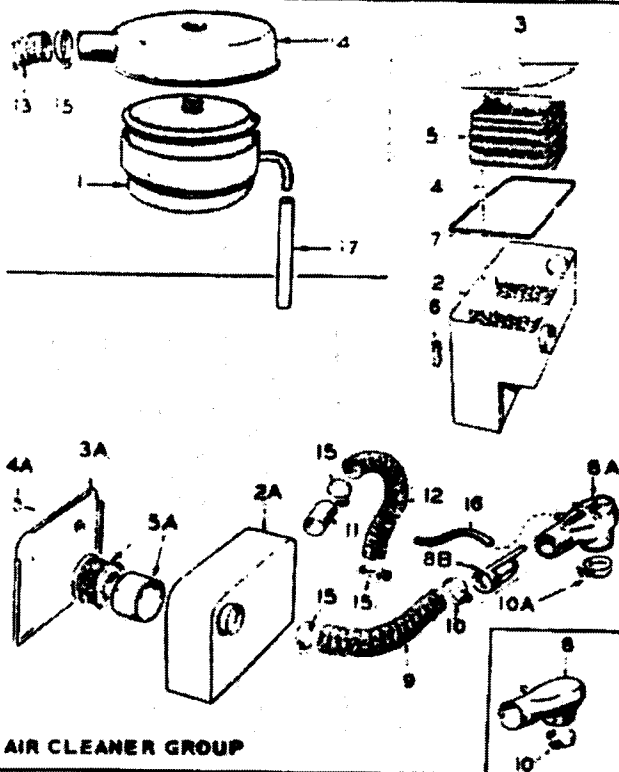


GOVERNOR & GEAR COVER GROUP

Note: Vacuum booster parts do not apply to X-Ray models (705CW-3R17/).

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	150A115	1	Spring, Governor
2	150A96	1	Stud, Gov. Sprg. Tension
3	150A398	1	Nut, Gov. Spd. Adj.
4	150A639	1	Joint Ball, Gov. Link (Repl. 150A300)
5	150A410	1	Link, Gov. Arm to Carb.
6	150A495	1	Bracket, Booster Ext. Sprg. Key 3,4,5,6
7	150A471	1	Spring, Ext. Booster - Key 3,4,5,6
8	150A425	1	Ring, Gasket - Booster to Man. - Key 3,4,5,6
9	150K580	1	Kit, Booster Repl. Key 3,4,5,6
10	150K582	1	Kit, Booster Diaph., Key 3,4,5,6
11	150A475	1	Spring, Booster - Int., Key 3,4,5,6
12	150A376	1	Bracket, Booster Int. Sprg., Key 3,4,5,6
13	150A666	1	Plate, Diaph., Booster, Key 3,4,5,6 (Repl. 150A373)
14	150A668	1	Gasket, Diaph. Plate, Key 3,4,5,6 (Repl. 150A374)

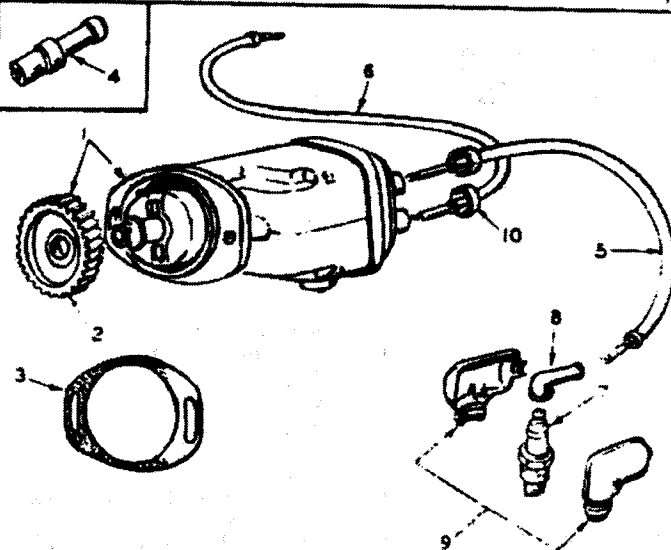
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
15	516-39	1	Pin, Cotter, Key 3,4,5,6
16	516-85	1	Pin, Roll, Key 3,4,5,6
17		1	Housing, Vacuum Booster (Not Sold Separately)
18		1	Cover, Vacuum Booster Hsg. (Not Sold Separately)
19	COVER, GEAR - ASSY., INCL. REF. 20-29		
	103C115	1	Spec. A
	103C173	1	Begin Spec. B (Repl. 103C140)
20	509-19	1	Seal, Oil - Crnkshft. Frt.
21	510-48	1	Bearing, Needle (Upper)
22	510-49	1	Bearing, Needle (Lower)
23	510-14	1	Ball, Brg., Shaft Thrust
24	509-46	1	Seal, Oil - Gov. Shaft
25	150A444	1	Yoke, Governor Shaft
26	516-90	1	Pin, Stop - Gov. Cup
27	150B416	1	Arm & Shaft Gov.
28	150A438	1	Screw, Adj. - Gov. Sensitivity
29	150A411	1	Bracket, Gov. Spring
x 30	103C110	1	Gasket, Gr. Cover Mtg.
x 31	520A363	1	Stud, Arm Cover Mtg. - Spec. A Only



AIR CLEANER GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	140A343	1	Cleaner, Air - Oil Bath Type, Spec. A (Repl. 140C266)
2	140D355	1	Housing, Mesh Type - Spec. B through F
2A	140D531	1	Housing, Cart. Type - Begin Spec. G
3	140B356	1	Cover, Mesh Type - Spec. B through F
3A	140B532	1	Cover, Cart. Type - Begin Spec. G
4	520A75	2	Stud, Mesh Type - Spec. B through F

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
5	40-359	1	Screw, Cart. Type - Begin Spec. G
5A	40B495	1	Element, Mesh Type - Spec. B through F
6	7-9	1	Cartridge & Wrapper, Begin Spec. G (Note: Wrapper not sold separately.)
7	40B467	1	Plug, Button - Spec. B through F
8	40A357	1	Gasket, Spec. B through F (Repl. 50B-73)
8A	145A239	1	Inlet, Carb. Air (Metal) Spec. B through H - Order 145A239
8B	145A246	1	Rub. Inlet, 145A246 Bushing, 503P368 Clamp
9	503B402	1	Inlet, Carb. (Air Horn) Rubber Begin Spec. J
10	503B402	1	Bushing, Carb. Air Inlet for Rubber Inlet - Begin Spec. J
10A	503B402	1	Hose, Air Clnr. to Carb. - Begin Spec. B (Repl. 503A263 & 503B42)
10	CLAMP, HOSE	1	Air Clnr. Hose to Carb. Inlet
10	503-274	1	Metal Inlet to Carb. - Spec. B through H
10A	503A368	1	Clamp, Hose - Rubber Inlet to Carb., Begin Spec. J
11	133A32	1 or 2	Tube, Air Pre-heater - Spec. A (1), Begin Spec. B (2)
12	503-259	1	Hose, Air Pre-heater - Begin Spec. B
13	503A215	1	Hose, Air Pre-heater - Spec. A
14	133K30	1	Pre-Heater Kit, Air - Spec. A (Incl. Air Adapter, Hose, Clamps & Tube)
15	503-269	3	Clamp, Hose - (2) Air Pre-heater Hose, (1) Air Clnr. Hose to Air Clnr.)
16	503A275	1	Hose, Breather Cap to Air Inlet (3-1/8") Begin Spec. B (See Also Optional Fuel System Group) Spec. A
17	123A411	1	Tube, Breather Cap to Air Clnr. (See Also Optional Fuel System Group) Spec. A
50B-31		1	Grommet, Rubber - Air Clnr. (For 11/32" Hole) Spec. B Through F

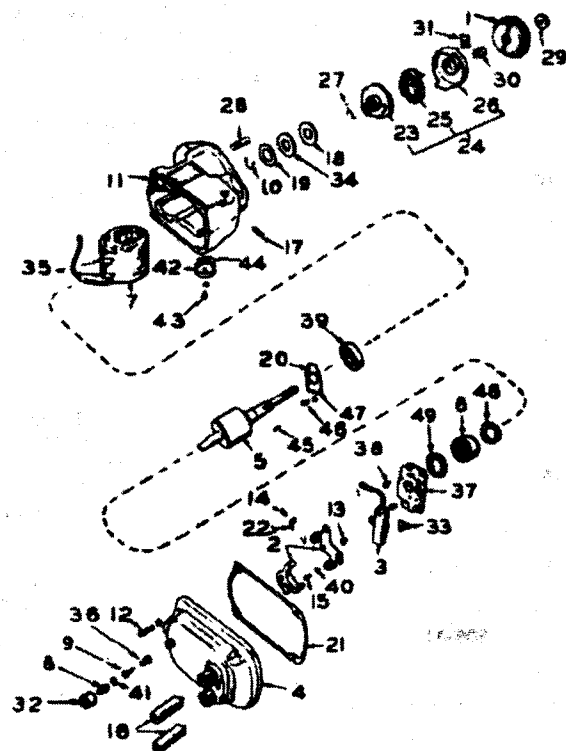


IGNITION GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	161C238	1	Magneto, Incl. Gear, Less Stop Button (Repl. 161A148)
2	160B339	1	Gear, Magneto Drive
3	160A124	1	Gasket, Magneto Mtg.
4	161P152	1	Button, Stop - Key 1,3
5	CABLE, SPARK PLUG - RIGHT HAND	1	Shielded, Key 1,2,3,4,6
6	167A1213	1	Unshielded, Incl. Seal, Key 5,6
7	167A1277	1	Shielded, Key 1,2,3,4,6
8	167A1214	1	Unshielded, Incl. Seal Key 5,6
9	167A1278	1	Plug, Spark (Repl. 167-35)
10	167-34	1	Nipple, Spark Plug
11	66-405	1	Shield, Spark Plug
12	57A41	1	Nut, Coupling - Spk. Plg.
13	67A57	1	Cables to Magneto
14	67-19	2	Seal, Rubber - Spk. Plg. Cable to Magneto - Key 5,6

MAGNETO PARTS GROUP (Type FM-PEI)

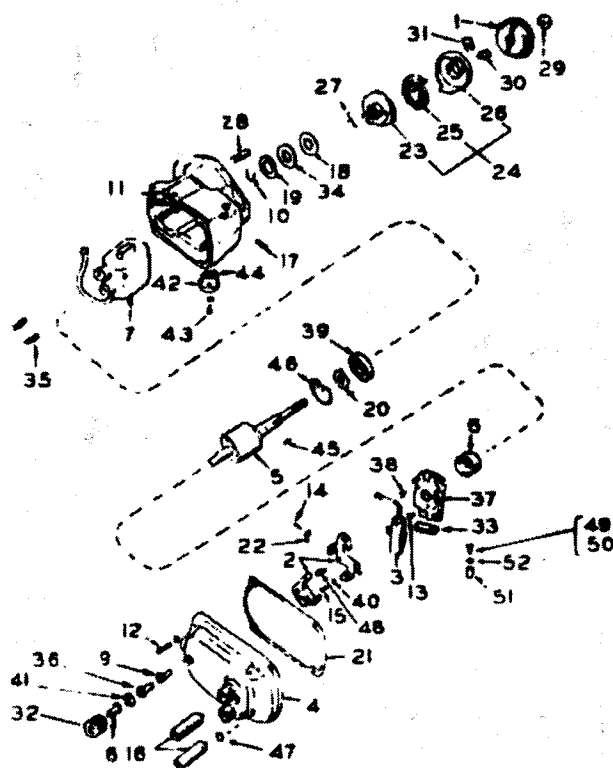
Note: These parts are for type FM-PEI-2869A magneto. Be sure to check magneto nameplate for type before ordering replacement parts.



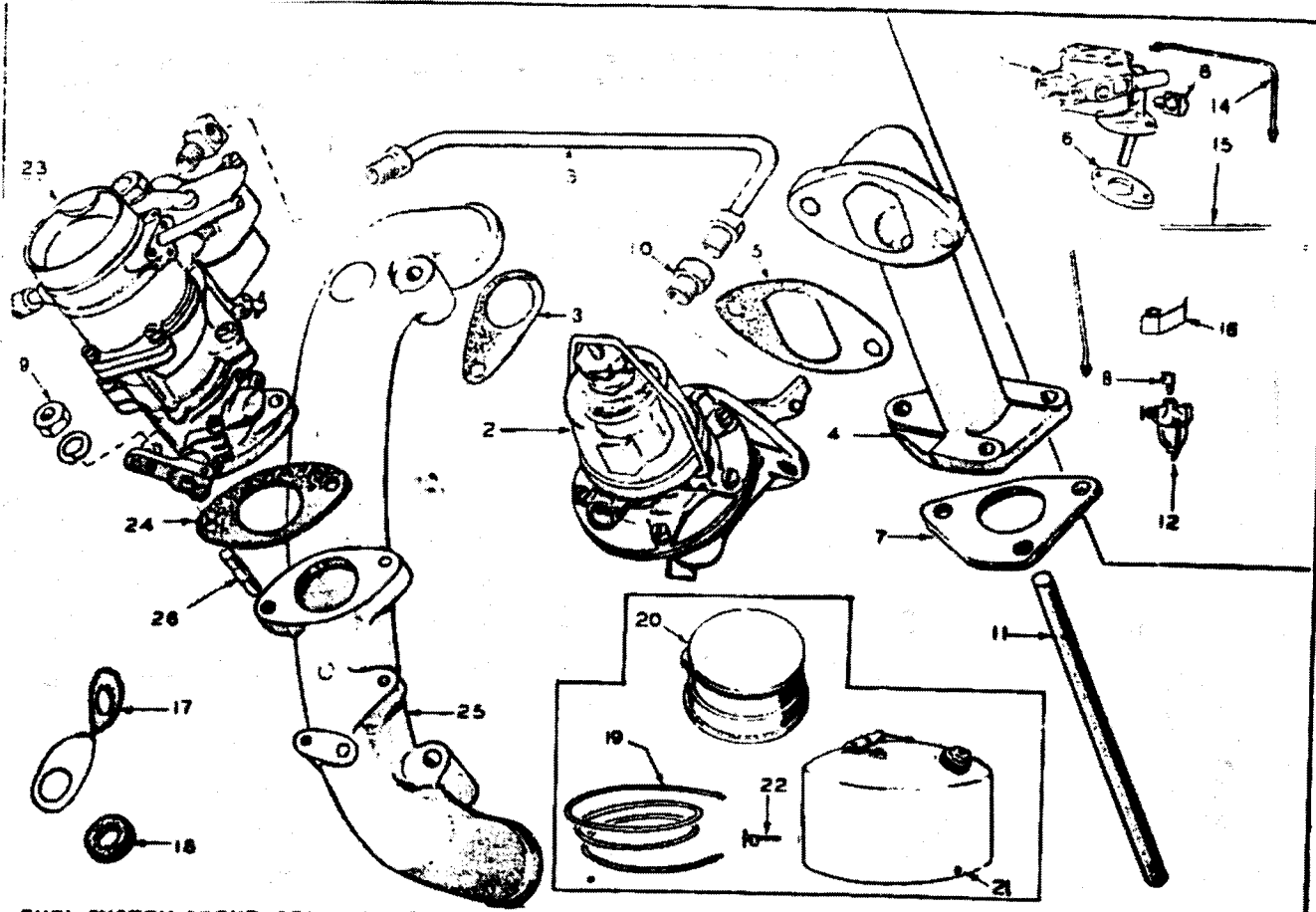
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	161C238	1	Magneto Assy., Incl. Dr. Gr., (Repl. 161A148)
1	160B339	1	Gear, Mag. Drive
2	161-242	1	Point Set, Incl. Arm & Stationary Brkt.
3	161A178	1	Condenser, Magneto
4	161P210	1	Cap, End
5	161P212	1	Rotor Assy., Magnetic
6	161P217	1	Bearing, Roller - Rotor Cam End
7	161P211	1	Coil, Magneto
8	161A11	1	Ferrule, Grd. Term.
9	161P118	1	Insulator, Grd. Term.
10	161-19	1	Ring, Drive Shaft Snap
11	161-236	1	Housing, Magneto
12	161-120	4	Screw, End Cap (10-24 x 5/8")
13	161P224	1	Screw, Condenser Mtg. (8-32 x 1/4")
14	161P223	1	Screw & Lockwasher, Brkr. Arm Term.
15	161P231	1	Screw & Lockwasher, Contact Support Locking (8-32 x 5/16)
16	161P123	2	Outlet, High Tension Cable
17	161P226	2	Set Screw, Coil Bridge
18	161-128	1	Washer, Rotor Dr. End Seal (Outer)
19	161P213	1	Washer, Rotor Dr. End Seal (Inner)
20	161P214	1	Washer, Rotor Dr. End Brg. Retaining
21	161P215	1	Gasket, End Cap to Hsg.
22	161-136	1	Spring, Contact Support Grd. Hub, Coupling
23	161-170	1	Hub, Coupling
24	161-243	1	Coupling Assy., Impulse - Incl. 23, 25, 26
25	161-51	1	Spring, Impulse Cplg. Dr. Shell, Impulse Cplg.
26	161-131	1	Shell, Impulse Cplg.
27	161-96	1	Spring, Impulse Cplg. Pawl
28	161-172	1	Pin, Impulse Cplg. Pawl Stop (3/8-16)
29	161-53	1	Nut, Impulse Coupling
30	161-135	1	Bushing, Impulse Coupling
31	161-240	1	Washer, Coupling Plate
32	161P164	1	Nut, Ground Cable
33	161P230	1	Wick & Holder, Cam
34	161-62	1	Seal, Rotor Drive End
35	161-186	1	Spring, Coil Lead
36	161-119	1	Terminal Ground Cable
37	161P216	1	Support, Bearing
38	814-77	4	Screw, Brg. Support (8-32 x 3/8")
39	161P71	1	Bearing, Rotor Drive End
40	526-3	1	Washer, Contact Support Locking Screw
41	161A79	1	Washer, Ground Terminal
42	161P219	1	Cover, Vent
43	161P220	1	Screw, Vent Cap (6-32 x 1/4")
44	161P221	1	Screen, Vent
45	515-1	1	Key, Rotor Shaft Impulse Cplg.
46	161-244	1	Screw, Rotor Dr. End Brg. Washer (8-32 x 3/8")
47	850-25	1	Lockwasher, Brg. Retainer Screw
48	161P232	1	Washer, Brg. Support Grease Retaining (Outer)
49	161P213	1	Washer, Brg. Support Grease Retaining (Inner)

MAGNETO PARTS GROUP (Type FM-JE1)

Note: These parts are for type FM-JE1-2B69A magneto. Be sure to check magneto nameplate for type before ordering parts.



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	1608339	1	Magneto Assy., Incl. Dr. Gr. (Order 161C238)
2	161-86	1	Gear, Magneto Drive
3	161A178	1	Point Set, Contact
4	161P210	1	Condenser Magneto
5	161-169	1	Cap, End
6	161-72	1	Rotor Assy., Magnetic
7	161-168	1	Bearing, Rotor Cam End
8	161A11	1	Coil, Magneto
9	161P118	1	Ferrule, Primary Grd.
10	161-19	1	Insulator, Primary Grd. Term.
11	161-236	1	Ring, Rotor Shaft Snap
12	161-120	4	Housing, Magneto
13	161P225	1	Screw, End Cap (10-24 x 5/8")
14	161P225	1	Screw, Condenser Mtg. (8-32 x 3/8")
15	161P225	1	Screw & Lockwasher, Brkr. Arm Term. (8-32 x 3/8")
16	161P123	2	Screw & Lockwasher, Contact Support Locking (8-32 x 3/8")
17	161-239	2	Outlet, High Tension Cable
18	161-128	1	Set Screw, Coil Bridge
19	161P213	1	Washer, Rotor Dr. End Seal (Outer)
20	161-56	As Req.	Washer, Rotor Dr. End Seal (Inner)
21	161A42	1	Shim, Rotor Dr. End Brg.
22	161-136	1	Gasket, End Cap to Mag.
23	161-170	1	Spring, Ground Switch
24	161-171	1	Hub, Coupling
25	161-51	1	Coupling Assy., Impulse - Incl. 23, 25, 26
26	161-175	1	Spring, Impulse Cplg. Dr.
27	161-96	1	Shell, Impulse Cplg.
28	161-172	1	Spring, Impulse Cplg. Pawl
29	161-53	1	Pin, Impulse Cplg. Pawl Stop (3/8-16)
30	161-135	1	Nut, Impulse Coupling
31	161-240	1	Bushing, Impulse Coupling
32	161P164	1	Washer, Coupling Plate
33	161-112	1	Nut, Ground Cable
34	161-62	1	Wick & Holder, Cam
35	161-186	2	Seal, Rotor Drive End
36	161-119	1	Spring, Coil Lead
37	161-173	1	Terminal, Ground Cable
38	814-77	4	Support, Bearing
39	161P71	1	Screw, Brg. Support (8-32 x 3/8")
40	526-3	2	Bearing, Rotor Drive End
41	161A79	1	Washer, Contact Support
42	161A219	1	Locking Screw Plate
43	161P220	1	Washer, Grd. Term.
44	161P221	1	Cover, Vent
45	515-1	1	Screw, Vent Cover (6-32 x 1/4")
46	161-18	1	Screen, Vent
47	161-241	1	Key, Rotor Shaft to Impulse Coupling
48	161-35	1	Ring, Rotor Bearing Snap
49	812-61	1	Washer, End Cap Plate
50	161-116	1	Screw, Contact Support Adj.
51	161-113	1	Screw, Cam Wick (6-32 x 3/8")
52	161-114	1	Lockwasher, Cam Wick Screw
			Spacer, Cam Wick
			Washer, Cam Wick

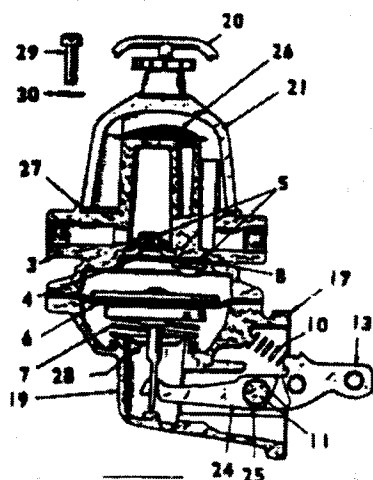
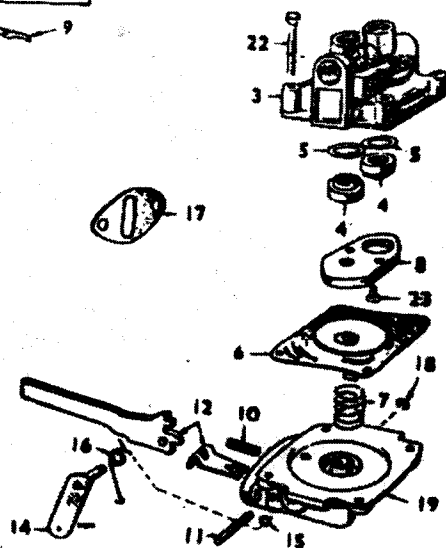


FUEL SYSTEM GROUP, STANDARD (See Also Optional Fuel System Group)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	149D693	1	Pump, Fuel Spec. A (Repl. 149C405 & 149C559)
2	PUMP, FUEL - BEGIN SPEC. B		
	149C567	1	Without Priming Lever - Key 2,4,5,6
	149C530	1	With Priming Lever - Key 1,3
3	154A252	2	Gasket, Intake Man. Mtg.
4	149C528	1	Adapter, Fl. Pump - Begin Spec. B
5	149A277	1	Gasket, Fuel Pump to Adapter Begin Spec. B
6	149A388	1	Spacer, Fl. Pump Mtg. - Spec. A
7	149A520	1	Spacer, Fl. Pump Adapter Mtg. - Begin Spec. B
8	502-2	As Req.	Elbow, Fuel Line Connection Spec. A (3), Begin Spec. B (2)
9	868-3	2	Nut, Carburetor Stud
10	502-3	1	Connector, Fl. Line - Fl. Pump Out. - Begin Spec. B
11	149A519	1	Rod, Push - Fl. Pump Adapter Begin Spec. B
12	149B79	1	Filter, Fuel - Spec. B to Serial 50B834
	LINE, FUEL - PUMP TO CARBURETOR		
13	149A533	1	Begin Spec. B
14	149B403	1	Spec. A
5	159B407	1	Line, Fuel - Supply Con. to Fl. Pump In. - Spec. A
6	149A171	1	Bracket, Fl. Supply Con. - Spec. A

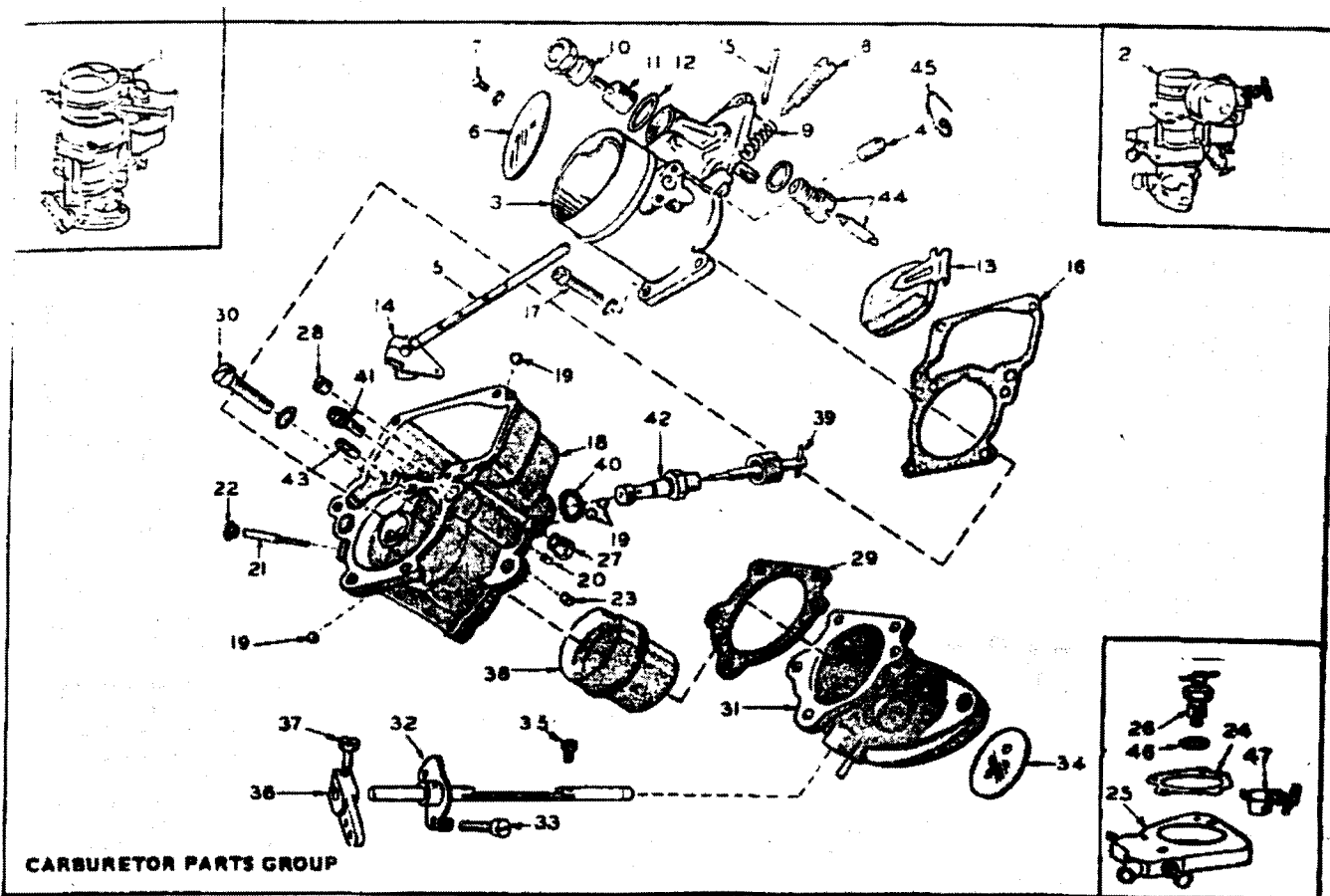
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
17	159A477	1	Bracket, Fl. Line Support - Begin Spec. B
18	508-21	1	Grommet, Rubber - Fl. Line Support Brkt. - Begin Spec. B
19	501A27	1	Line, Fl. Tank to Plant.
20	415A124	1	Cap, Rain - Rubber
21	415B126	1	Tank, Fl. (5-Gal.) - Repl. 415A10
22	504A13	1	Valve, Shut Off - Fl. Tank
23	CARBURETOR - GASOLINE		
	141C560	1	Key 1,2
	141C564	1	Key 3,5 (Also Key 4,6 - To Spec. F)
	141C621	1	Key 4,6 - Spec. F through K
	141C655	1	Key 4 - Begin Spec. L
24	154A133	1	Gasket, Carb. to Manifold
25	MANIFOLD, INTAKE		
	154D253	1	Key 1,2 - Spec. A (Note: Also for Key 4, X-RAY Only - Spec. A)
	154D314		Spec. B (Note: Also for Key 4, X-RAY Only - Begin Spec. B)
	154A266	1	Key 3,4 - Spec. A (Note: For Key 4, X-Ray Only - Use 154D253)
	154D315	1	Key 3,4,5,6 - Begin Spec. B (Note: For Key 4, X-RAY Only Use 154D314)
26	800-52	2	Screw, Hex Hd. Mach. - Carb. to Man. (3/8-16 x 1-1/2) - Repl. 520A311)

FUEL PUMP PARTS GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	49D693		Pump, Fuel - Spec. A (Repl. Blaking Mfr. Pump)
2	PUMP, FUEL - BEGIN SPEC. B		
	149C530		Key 1,3 (With Priming Lever)
	149C567		Key 2,4,5,6 (Less Priming Lever)
3			Body, Upper (Note Sold Separately)
4	149A96	2	*Valve & Cage
5	149A95	2	*Gasket, Valve
6	DIAPHRAGM & PULL ROD		
	149A582	1	**Spec. A
	149P276	1	£Begin Spec. B
7	SPRING, DIAPHRAGM		
	149A672	1	**Spec. A (Repl. 149A93)
	149P576	1	Begin Spec. B
8	RETAINER, VALVE		
	149A539	1	Spec. A (Repl. 149A84)
	149P575	1	Begin Spec. B
9	149A159	2	**Gasket, Valve Ret. - Spec. A (Blaking Mfr. Pump Only)
10	SPRING, ROCKER ARM		
	149A675	1	**Spec. A (Repl. 149A94)
	149P580	1	Begin Spec. B
11	PIN, ROCKER ARM		
	516A113	1	Spec. A (Repl. 516A25)
	149P578	1	Begin Spec. B
12	149-710	1	Arm & Link Set, Rocker (Sold only as a set) Spec. A
13	149P581	1	Arm, Rocker - Begin Spec. B
14	149A551	1	Lever, Primer - Spec. A (Onan Mfr. Pump Only)
15	509-65	2	Seal, O-ring - Primer Lever - Spec. A (Onan Mfr. Pump Only)
16	149A404	1	Spring, Priming Lever - Spec. A (Onan Mfr. Pump Only)
17	GASKET, MOUNTING		
	149A3	2	**Spec. A (Pump & Spacer Mtg.)
	149A277	1	£Begin Spec. B
18	518-129	1	Ring, E Retainer - Priming Lever Shaft - Spec. A (Onan Mfr. Pump Only)
19		1	Body, Lower (Not Sold Separately)
20	149P573	1	Bail, Bowl Retainer - Begin Spec. B
21	149A481	1	Bowl, Strainer - Begin Spec. B
22	815-148	4	Screw, Pump Assy., Spec. A
23	815-147	2	Screw, Valve Retainer, Spec. A
24	149P579	1	Link, Rocker Arm - Begin Spec. B
25	149P577	1	Bushing, Rocker Arm Pin - Begin Spec. B
26	149P483	1	Screen, Strainer - Begin Spec. B
27	149A275	1	£Gasket, Bowl - Begin Spec. B
28	149P793	1	£Seal, Diaphragm Pull Rod - Begin Spec. B - Note: Req. to maintain crankcase vacuum with pumps having lower body vent hole.
29	815-135	6	Screw, Body
30	850-30	6	Lockwasher, Body Screw
	REPAIR PARTS KIT, FUEL PUMP		
	149K526	1	Spec. A + Incl. Parts Marked * & **
	149K106	1	Begin Spec. B - Incl. Parts Marked £ & *

Note: All parts listed for Begin Spec. B Mdls. are for AC Mfr. Pump only. Carter Mfr. Pump (used during Spec. B prior to serial 508834) parts are not available, use pump assembly 149C567.



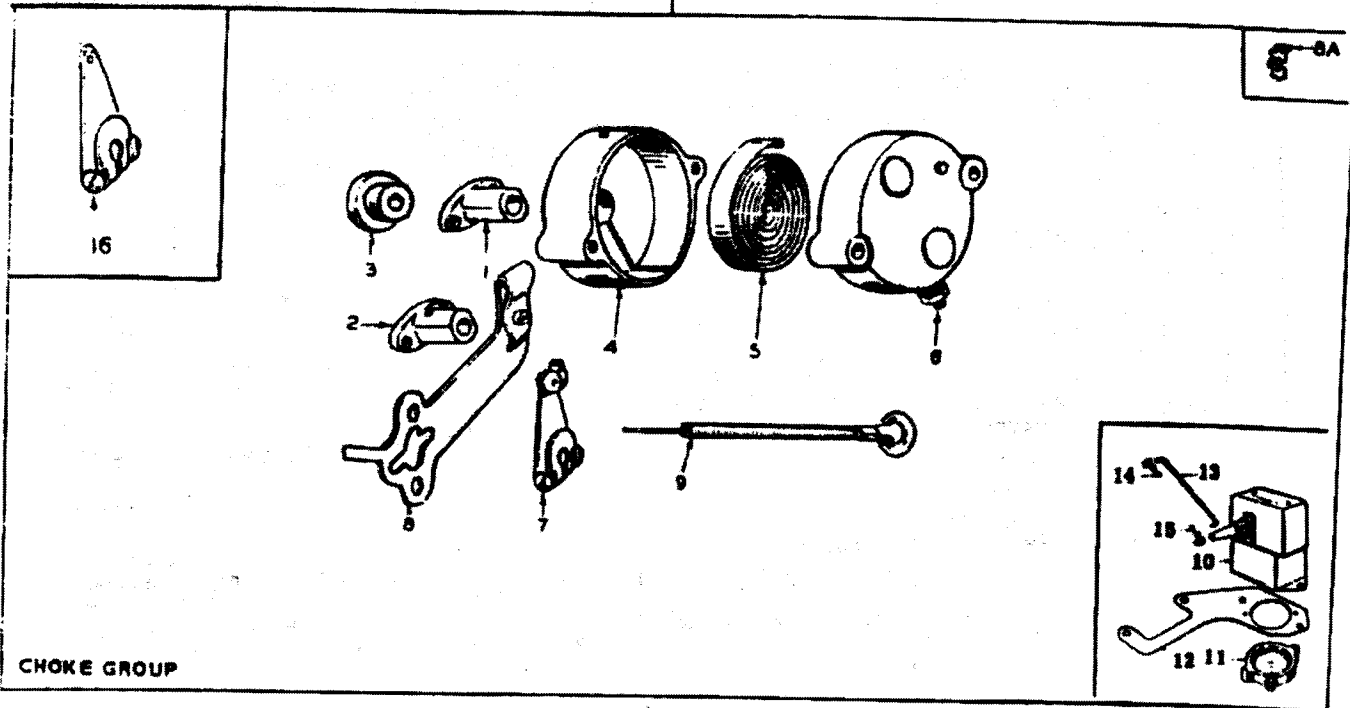
CARBURETOR PARTS GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	CARBURETOR - GASOLINE		
	141C560	1	Key 1,2
	141C564	1	Key 3,5 (Also Key 4,6 To Spec. F)
	141C621	1	Key 4,6 - Spec. F Through K
	141C655	1	Key 4 - Begin Spec. L
2	CARBURETOR - OPTIONAL FUEL		
	141C492	1	Gas-Gasoline - Key 2
	141C494	1	Gas-Gasoline - Key 4 - To Spec. F
	141C622	1	Gas-Gasoline - Key 4,6 - Spec. F Through K
	141C656	1	Gas-Gasoline - Key 4 - Begin Spec. L
	141C562	1	Gas (Only) - Key 2
	141C519	1	Gas (Only), Key 4,6
3	BODY, AIR INTAKE - INCL. CHOKE SHAFT BUSH.		
	141-530	1	To Spec. L
	141-666	1	Begin Spec. L
4	141-531	1	Bushing, Choke Shaft - To Spec. L
5	SHAFT, CHOKE		
	141A478	1	Key 1,2,3,5 (Also Key 4,6 - To Spec. F)
	141-624	1	Key 4,6 - Begin Spec. F
6	PLATE, CHOKE		
	141-532	1	To Spec. L
	141-667	1	Begin Spec. L
7	141-471	2	Screw, Choke Plate
8	141-8	1	Needle, Idle Adjusting
9	141-9	1	Spring, Idle Needle
10	141-533	1	Plug, Fuel Filter Head
11	141-566	1	Filter, Fuel Inlet
12	141-534	1	Washer, Gasket - Filter Plug
13	FLOAT		
	141-535	1	Gasoline Carburetor
	141A493	1	Gas-Gasoline Carb.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
14	153A214	1	Arm, Choke Shaft - Key 4,6 - Begin Spec. F
15	141-72	1	Axis, Float
16	141-536	1	Gasket, Intake to Bowl
17	141-537	6	Screw, Intake to Bowl
18	141-538	1	Bowl, Fuel - Incl. Ref. 19 through 23
19	141-539	4	Plug, Lead - Bowl Passages
20	141-540	1	Bushing, Idle Channel
21	141-541	1	Jet, Blank - Accelerator
22	141-542	1	Plug, Jet Channel - Accelerator
23	141-543	1	Plug, Accelerator Pump Rod Channel
24	148A198	1	Gasket, Gas Adapter - Gas or Gas-Gasoline Carb. Only
25	148B197	1	Adapter, Gas Fuel - Gas or Gas-Gasoline Carb. Only
26	148A135	1	Lock, Float - Gas-Gasoline Carb. Only (Not needed replace with pipe plug.)
27	141-70	1	Plug, Bowl Drain
28	141-544	1	Plug, Power Jet Channel
29	141-545	1	Gasket, Bowl to Throttle Body
30	141-546	2	Screw, Bowl to Body
31	141-585	1	Body, Throttle (Incl. Shaft, Plate & Brgs.)
32	141K586	1	Shaft & Lever Kit, Throttle - Incl. Stop Screw
33	815-133	1	Screw, Lever Stop
34	141-551	1	Plate, Throttle
35	141-257	2	Screw, Throttle Plate
36	141-552	1	Lever, Clamp - Throttle
37	141-2	1	Screw, Throttle Lever Clamp
38	VENTURI	1	Key 1,2 - Gasoline Carb.
	141-484	1	

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	41-5573		Key 1, 4, 5, 6 - Gasoline Carb.
	48A195		Key 2 - Gas or Gas-Gasoline Carb.
	48A195		Key 4, 6 - Gas or Gas-Gasoline Carb.
13	41-5553		Jet & Adj. Needle Assy., Main
14	41-5577	1	Washer, Main - Adj. Needle & Fuel Valve
15	41-5554		Jet, Idle
16	41-5555		Jet, Ch. Surge
17	41-5556		Jet, Main Vent
18	41-5573		Valve, Fuel Inlet

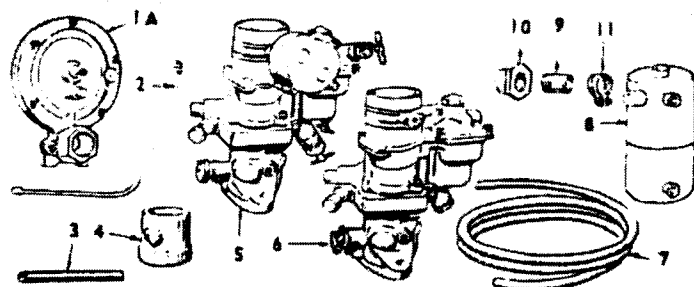
REF. NO.	PART NO.	QTY. USED	PARTS DESCRIPTION
19	41-450		Spring, Choke Stop - Gas-Gasoline Carb.
20	48A17		Gasket, Float Lock Bushing - Gas-Gasoline Carb.
21	50447		Valve, Gasoline In. Shut-off
	41-5550		Key 2, 4, 6 - Gas-Gasoline Carb.
	41-5563		Kit, Repair - Throttle Body Needle Bearing - Incl. Seal & Washer
	41-529		Kit, Repair - Carb.
			Kit, Gasket - Carb.



CHOKE GROUP

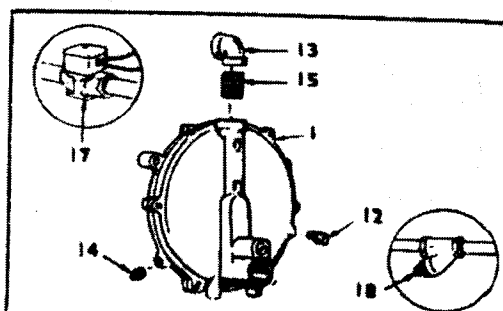
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	153A155	1	Adapter, Choke - For Gasoline (Only) Carb. - Key 2, 5 (Also Key 4, 6 - To Spec. F)
2	141A502	1	Adapter, Choke - For Opt. Gas-Gasoline Carb. - Key 2, 4, 5, - To Spec. L (Note: Used only as choke lock for Key 4 Spec. F through K)
3	41A372	1	Knob, Choke Shaft - Key 2, 5 (Also Key 4 - To Spec. F)
4	153A58	1	Housing, Choke Bimetal - Key 2, 5 (Also Key 4, 6 - To Spec. F)
5	53-57	1	Element, Bimetal - Key 2, 5 (Also Key 4, 6 - To Spec. F)
6	COVER, CHOKE - INCLUDES HEATING ELEMENT 153A162	1	*28-Volt - Key 2 (Also Key 4, 6 - To Spec. F)
7	53A50	1	*28-Volt - Key 5
8	LEVER, CHOKE SHAFT 153A60	1	Key 1, 3
	45-172	1	Key 6
9	BRACKET, CHOKE CONTROL ROD - KEY 1, 2, 6 141A496	1	To Spec. L
	53A347	1	Begin Spec. L
10	53A347	1	Choke Rod to Brkt. - Key 1, 3 Begin Spec. L

REF. NO.	PARTS NO.	QTY. USED	PARTS DESCRIPTION
9	ROD, CHOKE CONTROL 141A497	1	Key 1, 3
	153A18	1	Key 6
10	CHOKE, AUTOMATIC - SISSON - KEY 4, 6 153P213	1	Spec. F through K
	153A337	1	Begin Spec. L
11	153A346	1	Cover, Choke - Incl. Htg. Element, Key 4, 6, Begin Spec. F (Repl. 153A256)
12	153A252	1	Bracket, Auto. Choke - Key 4, 6 - Begin Spec. F
13	LINKAGE, AUTOMATIC CHOKE - KEY 4, 6 153A253	1	Gasoline (Only) Carb. - To Spec. L
	153A344	1	Gasoline (Only) Carb. - Begin Spec. L
	153A254	1	Optional Gas-Gasoline Carb. To Spec. L
	153A343	1	Optional Gas-Gasoline Carb. Begin Spec. L
	CLIP, END - CHOKE LINKAGE - KEY 4, 6 - BEGIN SPEC. F		
14	518-5	1	Carburetor End
15	519-47	1	Choke End
16	53A214	1	Arm, Choke Shaft - Key 6 - Begin Spec. F



OPTIONAL FUEL SYSTEM GROUP

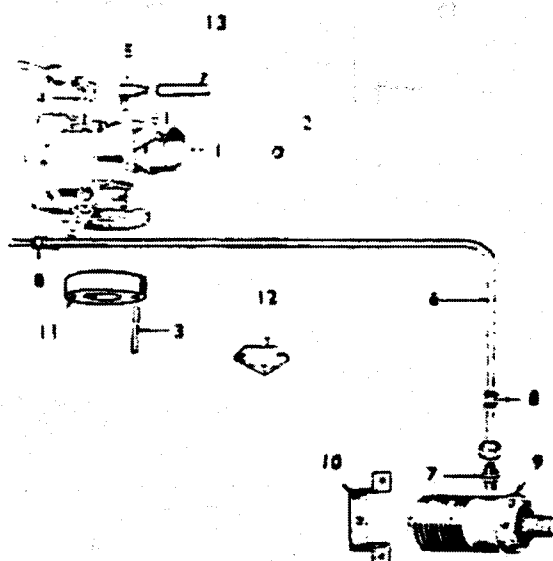
(Combination Gas-Gasoline or Gas Only, Downdraft Carburetor)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	REGULATOR, GAS (Check Reg. Nameplate for Manufacturer. Order Parts Accordingly)		
1	148C311	1	Garretson Manufacture- Used Begin Serial 573571 - Key 2,4,6
1A	148A428	1	Ensign Manufacture - Used Prior Serial 573571 - Repl. 148A9 - Key 2,4
2	LINE, GASOLINE - PUMP TO CARB. - GAS-GASOLINE MOLS. - KEY 2,4,6		
	149B431	1	Spec. A
	149A533	1	Begin Spec. B
3	TUBE, BREATHER (Rubber) GAS-GASOLINE & GAS MODELS		
	123A412	1	Key 2 - Spec. A
	503A267	1	Key 2 - Begin Spec. B (Use with Ensign Reg. Only)
	123A415	1	Key 4 - Spec. A
	503A266	1	Key 4 - Begin Spec. B (Use with Ensign Reg. Only)
	503A275	1	Key 4,6 - Spec. B Through E (Use with Garretson Reg. Only)
	503A318	1	Key 4,6 - Begin Spec. F (Use with Garretson Reg. Only)
4	148A214	1	Choke, Gas Fuel - Key 4 (Use with Ensign Reg. Only)
5	CARBURETOR - GAS-GASOLINE		
	141C492	1	Key 2
	141C494	1	Key 4 - To Spec. F
	141C622	1	Key 4,6 - Spec. F through K
	141C656	1	Key 4 - Begin Spec. L
6	CARBURETOR - GAS (Only)		
	141C562	1	Key 2
	141C519	1	Key 4,6

REF. NO.	PART NO.	QTY. USED	PARTS DESCRIPTION
7	503-51	1	Hose, Gas Reg. to Carb. (42")
8	159B294	1	Tank, Reservoir - Gravity Feed - Gasoline - Key 2,4
9	505-135	1	Nipple, Half - Gas Reg. Out. Key 2,4
10	505-131	1	Bushing, Gas Reg. Out., Use with Ensign Reg. Only - Key 2,4
11	CLAMP, GAS HOSE (Note: The O.D. of the Gas Fuel Hose varies, select appropriate clamps.)		
	503-27	2	3/4" O.D. Hose
	503-32	2	7/8" O.D. Hose
	503-49	2	15/16" O.D. Hose
12	148A107	1	Vent (Use with Garretson Reg. Only)
13	505-39	1	Elbow, Pipe - 3/8" (Used with Garretson Reg. Only) - Key 2,4
14	505-57	1	Plug, Pipe - 1/8" - Gas Reg. Key 2,4
15	505-101	1	Nipple, Pipe - 3/8" x 1" (Used with Garretson Reg. Only) Key 2,4
17	307P312	1	Valve, Sol. - Gaseous Fuel - Key 2,4
18	149-558	1	Strainer, Gaseous Fuel - Key 2,4
	148-300	1	Repair Kit, Gas Reg. (Ensign Model F)
	148-522	1	Repair Kit, Gas Reg. (Ensign Model F1)
	148-390	1	Repair Kit, Gas Regulator (Garretson)
	149A555	1	Cover, Crkcs. Fl. Pump Hole (Gas Only)

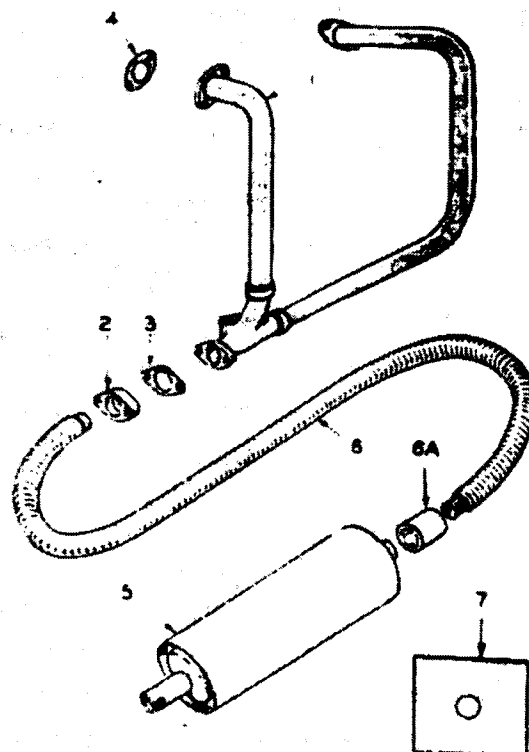
OPTIONAL FUEL SYSTEM GROUP (Liquid Petroleum Gas Only)

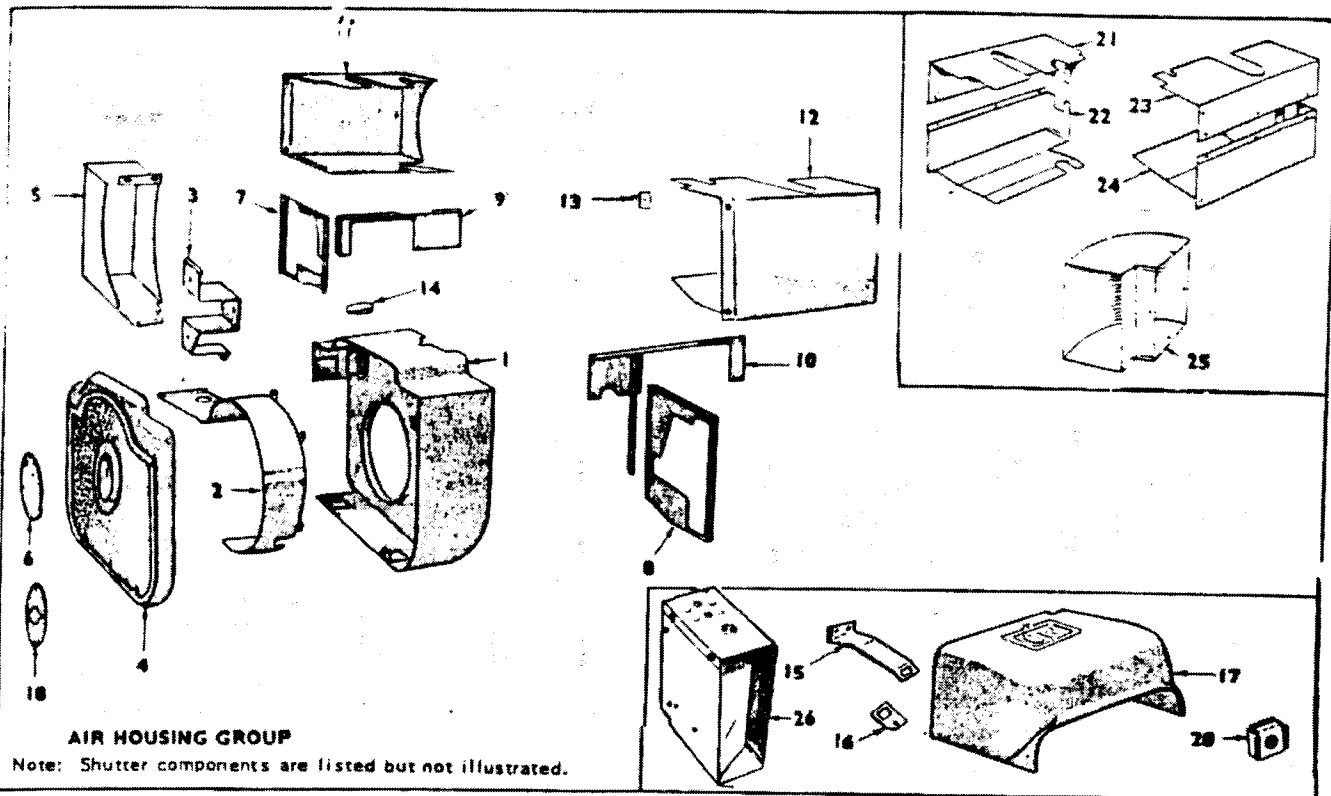


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	- 5671		Carburetor, Pressure - LPG Fuel - Combination Carb. & Press. Reg. (Components Not Available) - Repl. 141B637)
1	141B637	1	Seal, Throttle Shaft (Zenith 50-CT48-9) - Component of Carb. 141B637 & 141B671
3	520A429	2	Stud, Carb. Mtg. (3/8 x 2-1/2")
4	502-230	1	Elbow, Carb. Fl. In. (3/8" Male Pipe Thrd. by 3/8" Tube)
5	502-138	1	Elbow, Breather Hose to Carb.
6	148C429	1	Line, Fuel - Vapor, to Carb.
7	502-231	1	Union, Half - Vapor, Out. (1/4" Male Pipe Thrd. by 3/8" Tube)
8	332-50	2	Clip, Fuel Line to Eng.
9	148A418	1	Vaporizer Assy. (Mts. on Blower Hsg. Frt.)
10	148A423	1	Bracket, Vapor, Mtg.
11	145A231	1	Spacer, Carb. to Intake Man.
12	149A555	1	Cover, Crankcase Fuel Pump Hole
13	503A366	1	Tube, Breather (Rubber) - Air Cleaner

EXHAUST GROUP

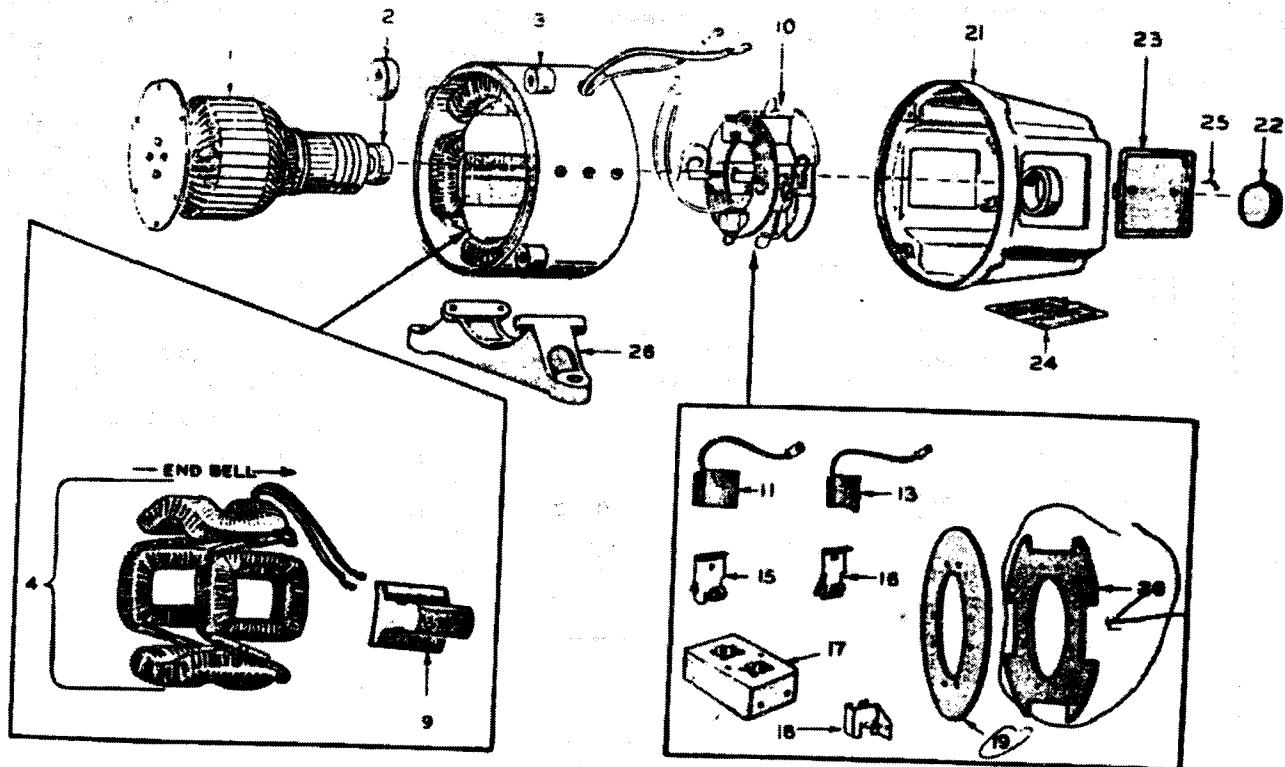
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	MANIFOLD, EXHAUST		
1	155C352	1	Horizontal Outlet, All Except Key 6 (Specs. 2203 & 2537)
	154D562	1	Vertical Down, Optional
	154C727	1	Key 6 (Spec. 2203 Only)
	154D761	1	Key 6 (Spec. 2537 Only)
2	155A170	1	Adapter, Exh. Man. Out.
3	154A133	1	Gasket, Exh. Adapter
4	155A343	2	Gasket, Exh. Manifold
5	55B77	1	Muffler, Exhaust
6	155B492	1	Tube, Exh. - Flexible
6A	505-31	1	Coupling, Pipe - Exh. Tube
7	554294	1	Plate, Gnd. - Exh. Tube





REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	HOUSING, BLOWER		
	134D394	1	Spec. A
	134D462	1	Key 1,2,3,4,6 (Except Spec. 2537)
	134D1228	1	Key 6 (Spec. 2537 Only)
	134D503	1	Key 5
2	SCROLL, BLOWER HOUSING		
	134D396	1	Key 1,2,3,4,5,6 (Except Spec. 2203)
	134A1095	1	Key 6 (Spec. 2203 Only)
3	134B397	1	Grille, Air Outlet
4	PANEL, BLOWER HSG. FRONT - WITH INTE - GRAL CRANK GUIDE		
	134E999	1	All Except LPG Plts. & Key 6 (Spec. 2203 Only) - Repl. 134E408
	134B1020	1	LPG Plts. (With Prov. for Mtg. Vaporizer)
	134A1169	1	Key 6 (Spec. 2203 Only)
5	134D423	1	Adapter, Air Outlet
6	134B471	1	Cover, Crank Opening - Spec. B Only
7	134B398	1	Plate, Baffle - L.H. Cyl.
8	134B399	1	Plate, Baffle - R.H. Cyl.
9	134B402	1	Extension, L.H. Baffle Plate
10	134B403	1	Extension, R.H. Baffle Plate
11	SHROUD, LEFT HAND CYLINDER		
	134B437	1	Spec. A - Incl. Fasteners
	134D458	1	Begin Spec. B
12	SHROUD, RIGHT HAND CYLINDER		
	134B438	1	Spec. A - Incl. Fasteners
	134D459	1	Begin Spec. B, Key 1,2,3,4,6
	134D576	1	Key 5
13	134A487	2	Bracket, Shroud - Begin Spec. B
14	517-9	1	Plug, Button - Pre-Htr. Tube Air Out.
15	CATCH, SHROUD FASTENER - SPEC. A ONLY		
	134B414	1	Right Hand Lower
	134A413	1	Left Hand Lower

REF. NO.	PART NO.	QTY. USED	PARTS DESCRIPTION
16	CATCH, SHROUD FASTENER - SPEC. A ONLY		
	134A411	1	Right Hand Upper
	134A410	1	Left Hand Upper
17	150C454	1	Cover, Gov. Arm - Spec. A Only
18	192B266	1	Plate, Crank Support - Begin Spec. C & Discontinued During Spec. G
20	NUT, SPEED GRIP (Blower Housing)		
	870-110	2	1/4-20, Thin
	870-111	2	1/4-20, Thick
	870-114	4	5/16-18
21	134C1218	1	Shroud, Cyl. - Upper L.H. - Key 6 (Spec. 2428 Only)
22	134C1219	1	Shroud, Cyl. - Lower L.H. - Key 6 (Spec. 2428 Only)
23	134C1220	1	Shroud, Cyl. - Upper R.H. - Key 6 (Spec. 2428 Only)
24	134C1221	1	Shroud, Cyl. - Lower R.H. - Key 6 (Spec. 2428 Only)
25	134C1208	1	Elbow, Air Outlet Adapter - Key 6 (Spec. 2428 Only)
26	134C892	1	Shutter, Auto. - Air Discharge (Opt. Accessory) Repl. 134C884 - Applies Only to 6-1/2" Long Shutter Assy. Used After 1958 - Incl. Parts Marked * Plus Hdw.
	134D893	1	*Extension, Air Discharge Adapter
	134C880	1	*Plate, Vernatherm Element Mtg.
	134A885	1	*Shaft, Shutter & Pin Assy.
	134B660	1	*Bracket, Vernatherm Mtg.
	309P85	1	*Element, Vernatherm Power
	134A656	1	*Spring, Vernatherm Element
	134A658	1	*Spring, Shutter
	309P77	1	*Switch, High Air Temp. Cutoff
	160A144	1	*Strap, Switch Grdg.
	332-47	3	*Clip, Lead Securing
	336A1090	1	*Lead, Switch to Stop Circuit



GENERATOR GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	*	1	Armature - Incl. Brg. & Drive Disc
2	510A52	1	Bearing, Ball - Armature (Repl. 510A2)
3	*	1	Frame - Machined & Drilled, Less Coils & Pole Shoes
4	*	1	Coil Set, Field - Set of 4
5	*	1	Coil, Commutating (Interpole) Key 5
6	*	4	Shoe, Pole
10	*	1	Rig Assy., Brush - Incl. Brushes & Springs
11	BRUSH, COMMUTATOR -		
	214A45	4	Spec. A, Key 1,2,3,4
	214A57	4	Begin Spec. B, Key 1,2,3,4,6
	214A49	4	Key 5
13	BRUSH, COLLECTOR RING -		
	214A46	8	Spec. A
	214A54	8	Begin Spec. B (Some Plts. Use 6)
15	212B1106	4	Spring, Commutator Brush
16	212B1123	8	Spring, Coll. Ring Brush (Some Plts. Use 6)
17	212B1120	4	Block, Holder - Coll. Ring Brush
19	GUIDE, COMMUTATOR BRUSH		
	212A1121	4	Key 1,2,3,4,6
	212A1101	4	Key 5

REF. NO.	PART NO.	QTY. USED	PARTS DESCRIPTION
19	RING, INSULATOR - BRUSH GUIDE		
	213B106	1	Spec. A, All Key Nos.
	213B116	1	Begin Spec. B, Key 1,2,3,4,6
	213115	1	Key 5
20	SPIDER, BRUSH RIG MOUNTING		
	212B1119	1	Spec. A, All Key Nos.
	212B1138	1	Begin Spec. B, Key 1,2,3,4,6
21	BELL, END		
	211D76	1	Spec. A, All Key Nos.
	211D91	1	Begin Spec. B, Key 1,2,3,4,6 (Except Spec. 2206)
	211D90	1	Key 5
	211A140	1	Key 6 (Spec. 2206 Only)
22	COVER, BEARING		
	232A601	1	Key 1,2,3,4,6 (Except Spec. 2206)
	232A1031	1	Key 5 (Key 6, Spec. 2206 Only)
23	COVER, END BELL OPENING		
	232B814	3	Key 1,2,3,4,6 - Top & Sides
	232B1089	2	Key 5 - Top
	232B1093	1	Key 5 - Lower Left
	232B1162	1	Key 5 - Lower Right
24	232B841	1	Cover, End Bell Opening - Key 1,2,3,4,6 - Bottom
25	232A615	1	Clip, Bearing Stop
26	232C784	1	Support, Gen. Frame

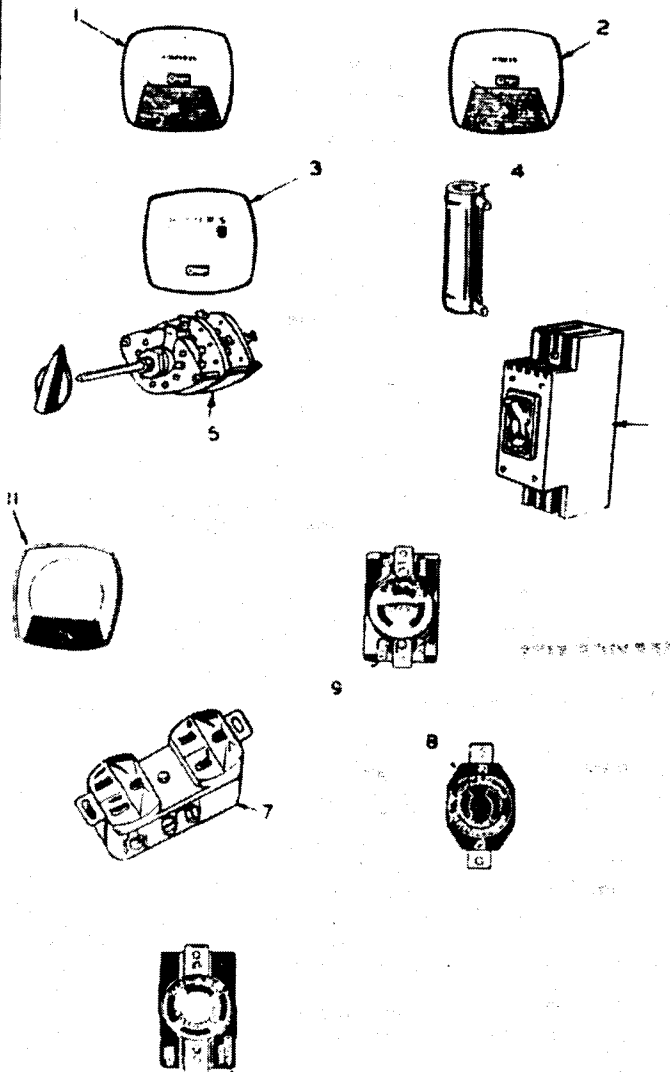
* - Order by part description, giving plant Model, Spec. and Serial Number.

REF. NO.	PART NO.	QTY. USED	PARTS DESCRIPTION
23	332A333	1	2-Place - Key 2,4,6 - Begin Spec. B
	MARKER, TERMINAL BLOCK		
24	332A438	1	Key 2,4 - Spec. A (4,5,6)
25	332A483	1	Key 2,4,6 - Begin Spec. B (5,A)
	332A426	1	Key 5 (1,2,3)
26	RESISTOR, VOLTAGE REGULATOR - KEY 2,4,6		
	304-121	1	Spec. A (10-Ohm, 10-Watt)
	304-251	1	Begin Spec. B (30-Ohm, 5-Watt)
	RESISTOR, CHARGE - KEY 2,4		
27	304A256	3	To Spec. H (6-Ohm, 75-Watt)
27A	304A483	1	Begin Spec. H (3 - 6-Ohm, 225-Watt)
28	309-10	1	Switch, Ign. Cut-Off - Low Oil Press. (Opt.)
29	308-97	1	Switch, Low Oil Press. Switch By-Pass (Repl. 308-37) Opt.
30	301CB53	1	Cover, Control Box - Key 2,4,6
31	*		Cable, Stop & Choke Circuits Key 2,4,6
32	SWITCH, REMOTE CONTROL START - STOP		

REF. NO.	PART NO.	QTY. USED	PARTS DESCRIPTION
	308A165		Key 2,4 (Repl. 308A94)
	308A9	1	Key 6
33	CABLE, BATTERY		
	416A77	2	Key 2,4,5,6 (Except Spec. 2428)
	416A38	2	Key 6 (Spec. 2428 Only)
34	416A4		Cable, Battery Jumper, Key 2,4,6 (Repl. 416A1)
35	307B597		Relay, Choke Disconnect - Key 4,6 Spec. F Through K (Repl. 307B4) Not used on plts. with manual choke.
36	301A974	1	Bracket, Start-Stop Switch Mtg., Key 2,4,5,6 For 308-90 Switch Only)
37	323A207	1	Receptacle, Key 6 (Spec. 2206 Only)
38	301A878	1	Plate Control Box Panel - Key 6
	303-84	1	Rheostat, Volt. Control, Key 5

* - Order by description giving complete Model, Spec., and Serial Number.

OPTIONAL AC METER PANEL EQUIPMENT GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	AMMETER		
	302-335		0-20 Amperes
	302P418	As	0-30 Amperes (Repl. 302-5)
	302P444	Req.	0-35 Amperes
	302P419		0-50 Amperes (Repl. 302-7)
2	VOLTMETER		
	302P420	As	0-150-Volts (Repl. 302-40)
	302P421	Req.	0-300-Volts (Repl. 302-41)
3	METER, RUNNING TIME - 115-V		
	302-212		60-Cycle
	302-102		50-Cycle
4	RESISTOR, RUNNING TIME METER		
	304P99		230-V
	304P125		460-V
5	308-12		Switch, Selector - Voltmeter
6	CIRCUIT BREAKER		
	320P18	As	20-Amperes
	320P19	Req.	25-Amperes
	320P58		30-Amperes
	325K2		35-Amperes
	320P52		50-Amperes
7	323P184	As Req.	Receptacle Dup - 2-Wire Plus Ground - 15-Amp
8	323-23	As Req.	Receptacle, 2-wire Twistlock 20-Amp
9	323-11	As Req.	Receptacle - 3-wire Twistlock 20-Amp
10	323-91	As Req.	Receptacle - 4-wire Twistlock 20-Amp
11	302B448	As Req.	Plate, Meter Face

STARTING MOTOR & CHARGING GENERATOR GROUP (Not Illustrated)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	91P26		*Motor, Starting - 6-V
	91A16		Jumper, Starter Connection - Copper
	91P105		**Generator, Charge 6-V
	91C90		Guard, Belt - Charge Gen.
	91P17		Belt, Generator Drive
	91P25		Pulley, Generator
	91A7		Key, Generator Pulley
	91B91		Bracket, Generator

- * - For service or parts, contact Prestolite service, giving starter no. from nameplate.
- ** - For service or parts, contact Delco service, giving generator no. from nameplate.

THE FOLLOWING SPECIAL CONTROL PARTS ARE OPTIONAL AS USED ON MODEL KEY 6, SPEC. 1850 ONLY (Not Illustrated)

Note: Control box is wall mtd. type. AC output leads are terminated in Junction Box.

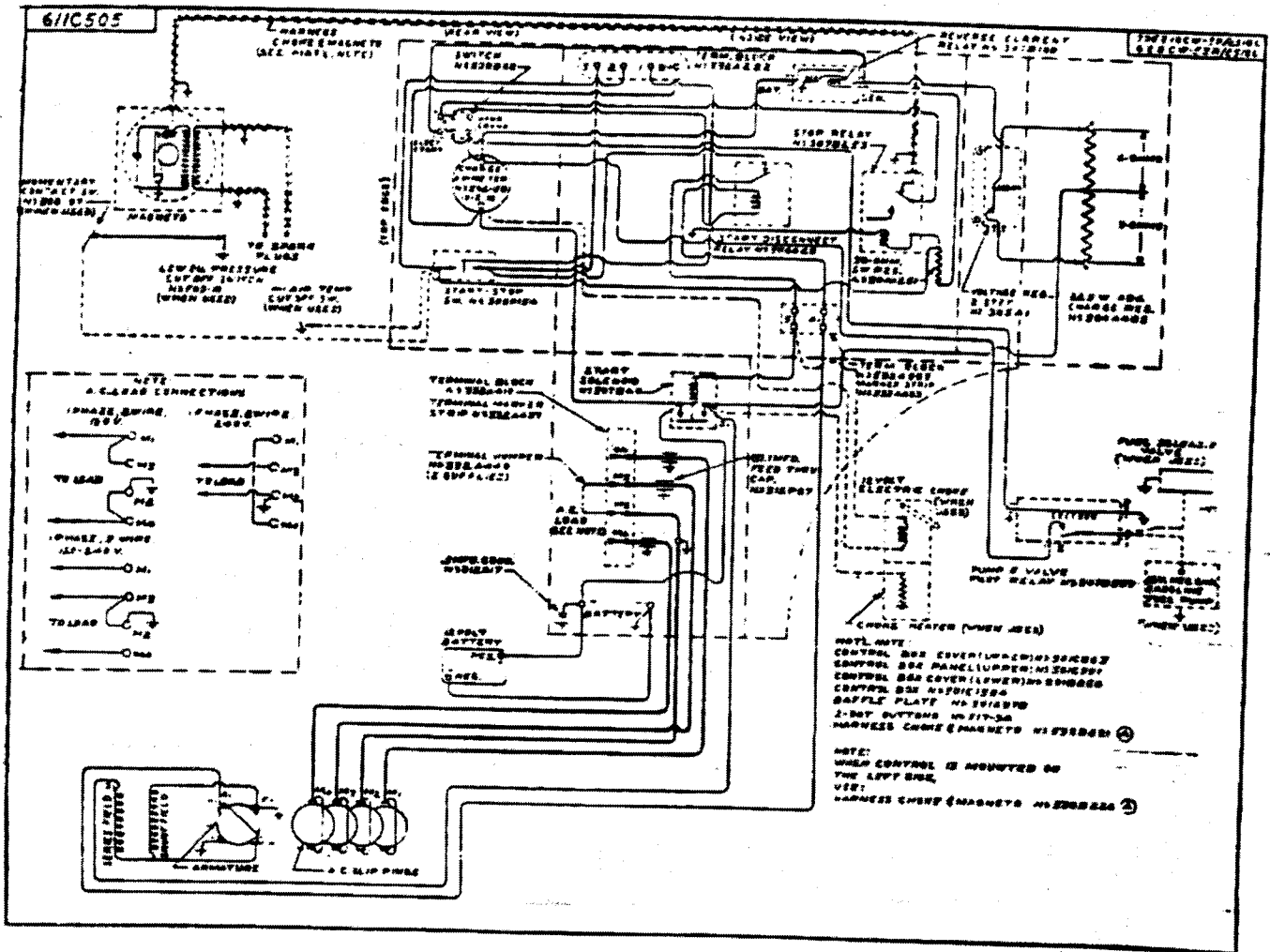
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	302-212	1	Meter, Running Time
	308-68	1	Switch, Run-Stop-DRDT
	332A607	1	Block, Term. - 12-Place
	332A642	1	Strip, Marker - Blank
	308A29	1	Switch, Start
	338C235	1	Harness, Wiring
	301O1852	1	Box, Control
	301B1853	1	Panel, Control Box
	301C1854	1	Bracket, Control Box Mtg.
	301B1855	1	Box, Resistor
	508-26	1	Grommet, Rubber (3/8") Mtg. Bracket
	508-1	1	Grommet, Rubber (3/4") Output Box
	508-8	1	Grommet, Rubber (1/2") Output Box
	330-28	1	Box, AC Output
	330-6	1	Cover, AC Output Box

SERVICE KITS

Note: For other kits, refer to the group for the part in question.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	168K56	1	Gasket Kit, Plant - Complete
	525P90	As Req.	Paint, Touch-up (Press. Can)
	525P137		12-oz. - Mouse Grey Enamel
			Paint, Touch-up (Press. Can)
			16-oz. - Green Enamel
	522K131	1	Overhaul Kit, Spec. A Only
			Key 1,2,3,4
	522K138	1	Overhaul Kit, Spec. B through J - Less Fuel Pump Kit - Key 1,2,3,4
	522K210	1	Overhaul Kit, Spec. K through L - Less Fuel Pump Kit - Key 1,2,3,4

BEGIN SPECIFICATION "L"



WIRING DIAGRAM #611C506
THREE PHASE MODELS
PENN STATE GASEOUS FUEL PLANTS
BEGIN SPECIFICATION "L"

